The FOUNDRY

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Castings Open and Close Garage Doors

DID you ever drive home from the theater in a pouring rain, happy in the thought that you could be in the dry on such a dark and stormy night, and then after you arrived home safe and dry, be forced to get out of the car to open the garage doors? Result—one suit ready for the presser and a ruined disposition. However,

Courtesy Yoder-Morris Co., Cleveland

An Electric Motor, Controlled by a Conveniently Located Button, Opens and Closes the Garage Doors

man's ingenuity again has succeeded in fooling the elements and today the garage doors may be opened mechanically. A mechanical door operator, driven by an electric motor, may be adapted to any type of door, either on a private or a public garage, and the device may be controlled from any convenient position with an electric button. In a private garage, the doors may be opened and the building flooded with light simply by inserting a key in a cast-iron post conveniently located beside the driveway, or by pushing a button in the house. In public garages the doors may be opened and closed from numerous places within the building simply by pressing a button, thus rendering quicker service to the customer and saving heat and the time that would be required for a man to open and close the doors. As is the case in practically all machines designed to serve man, castings are used extensively in the construction of the device. The frame, gears, and the control posts all are foundry products.

Find Where Castings Can Be Sold.

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BUICK Meets Peak

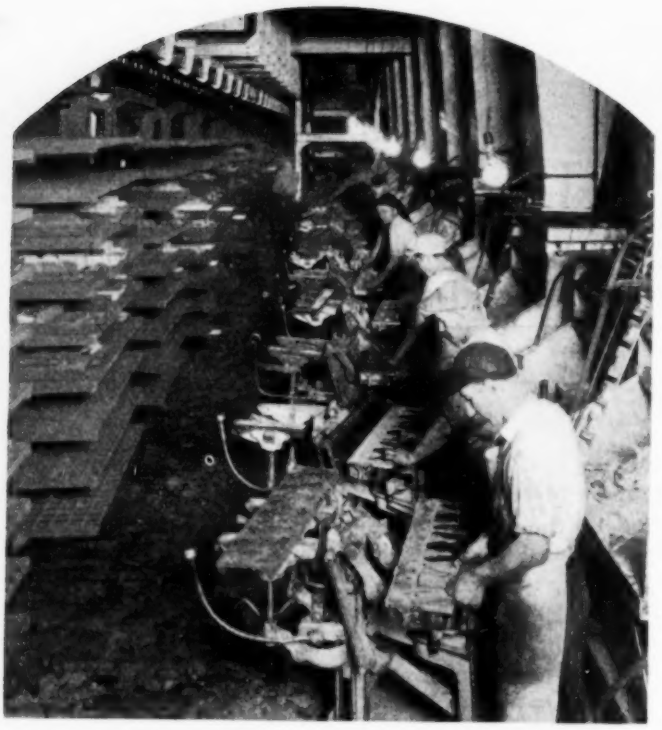


Fig. 1—Typical Aisle in the Coreroom Where Small Cores Are Made

THIS is the first of three articles describing the methods and equipment employed in the new foundry recently placed in operation at Flint, Mich., by the Buick Motor Co. The second, dealing in detail with molding and sand handling features, will appear in an early issue.—The Editors.

RECENTLY the Buick division of the General Motors Corp., completed and placed a foundry in operation at Flint, Mich., a foundry which confidently is claimed to be as nearly ideal as a foundry can be.

For the past several years production schedules have exceeded the capacity of the first plant foundry placed in operation early in 1917 and designed for what was considered at that time, the enormous daily melt of 250 tons. Eventually, the daily production was pushed up to 350 tons and when that demand was exceeded the castings were ordered elsewhere. For some time this outside tonnage has been creeping up until it amounts approximately to as much as is turned out in the home plant. Castings have been secured from other shops of the corporation and from independent foundries specializing in the production of automobile castings.

Although a new foundry to take care of this overflow work and a possible increase in total volume, was considered tentatively from time to

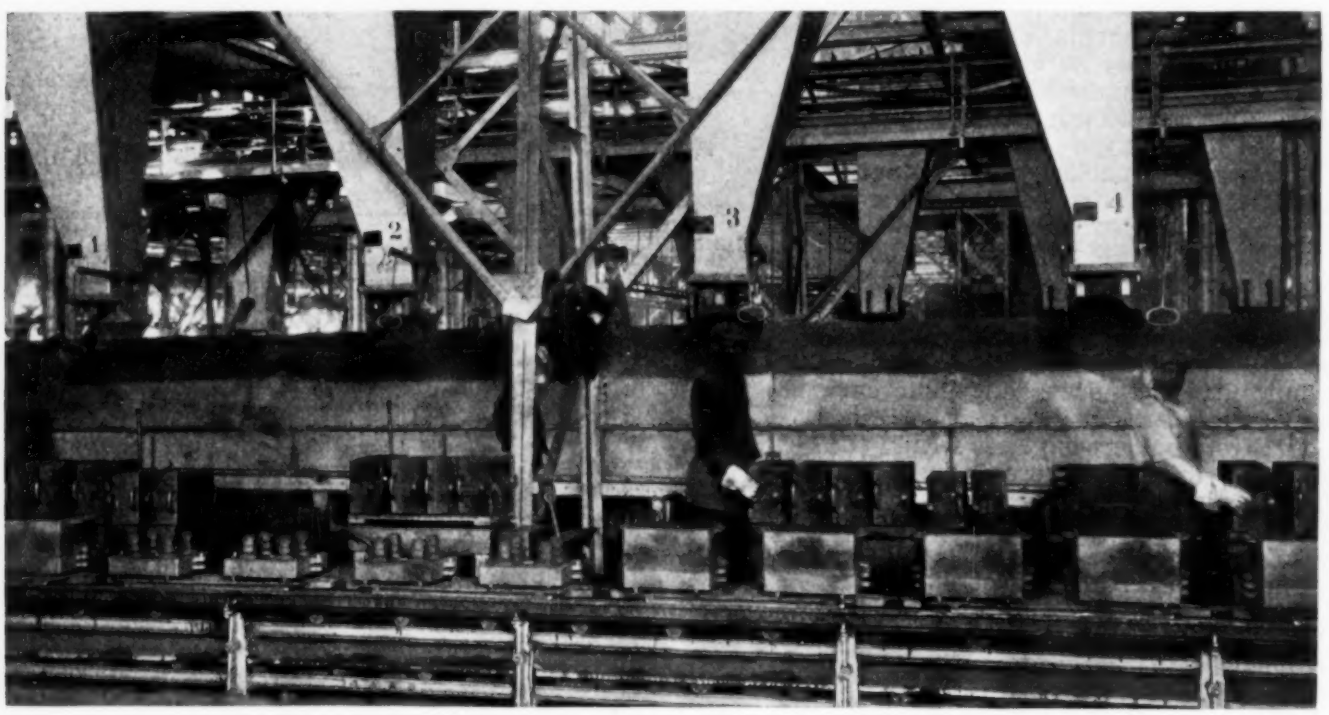


Fig. 2—Pistons, Molds and Cores Are Made Four in a Flask in Green Sand and Gated at the Bottom. They Are Assembled and Poured as They Move Along

FOUNDRY
kload Needs

By Pat Dwyer

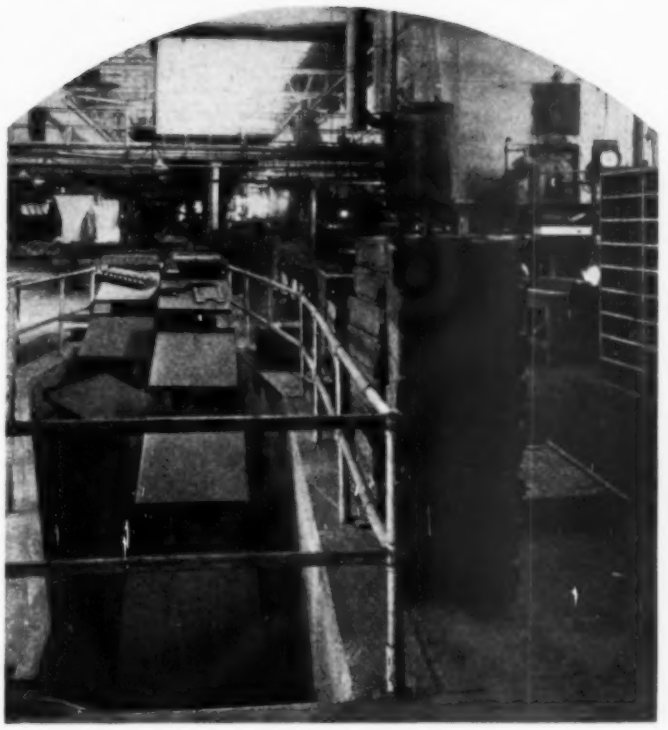


Fig. 4—Core Oven End of One of the Three Core Conveyors Which Carry Cores to the Molding Units

time, final decision was not reached until the fall of 1926. A general order to build a new foundry with a potential capacity of 700 tons a day was issued on Oct. 6, 1926 and the first heat was poured 10 months later, early in August, 1927. The cost of the building and equipment, it is claimed, ran close to $6,000,000.

While the project was in contemplation, executives of the company and members of the engineering staff visited prominent and up-to-date foundries elsewhere, including the Central foundry of the corporation at Saginaw and that of the Cadillac at Detroit. These foundries were built in 1920 and 1925 respectively after a sufficient length of time had elapsed to test out many of the new and revolutionary features incorporated in the new Buick foundry built in Flint in 1917.

Naturally in a breath taking industry, where production methods have been whipped up to keep pace with an output that has increased from a few hundreds to over four million per year in the comparatively short period of approximately 20 years, many features in existing foundries were found to be obsolete. Others subject to slight adaptation were viewed with favor and some of the methods and equipment were judged to be worthy of duplication in the new shop. Almost without exception the same manufacturers of foundry equipment who supplied the first Buick foundry in 1917, also equipped the new

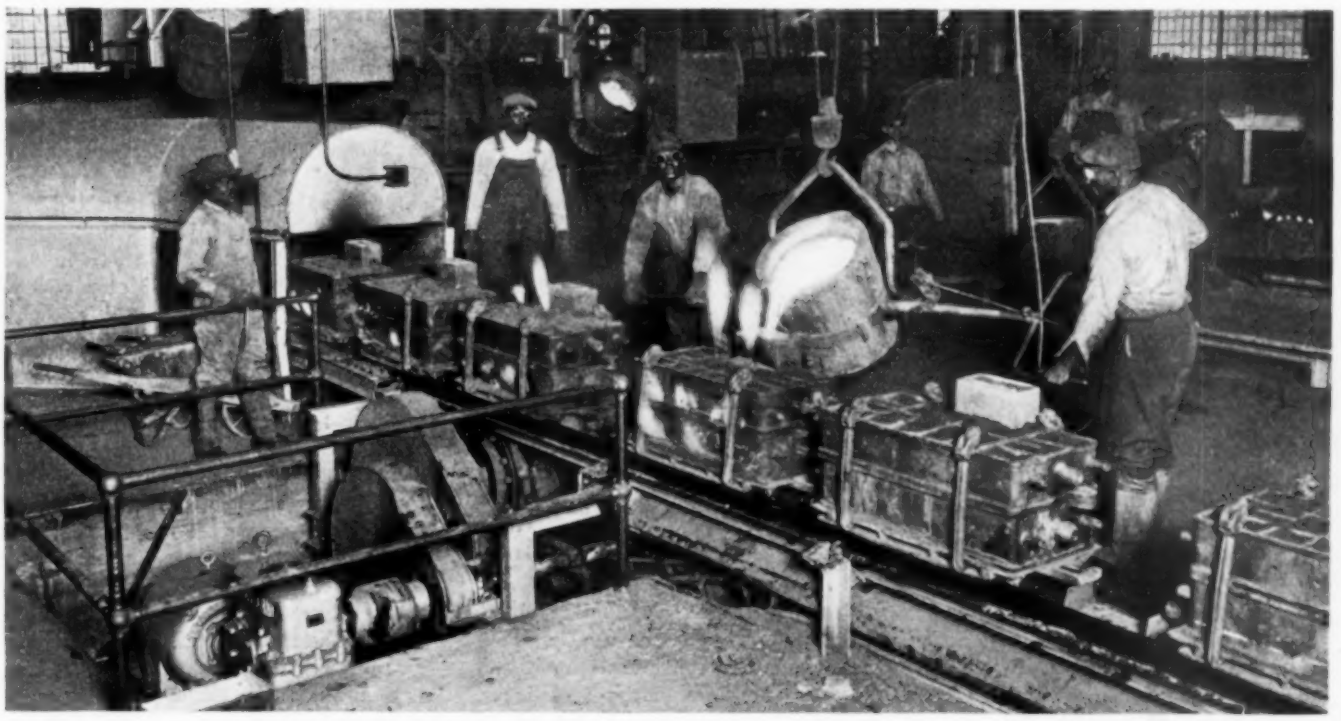


Fig. 3—Cylinder Molds Are Poured Close to the Smoke Hood and Travel Along While Cooling to Emerge at the Shakeout Located at the Far End of the Conveyor

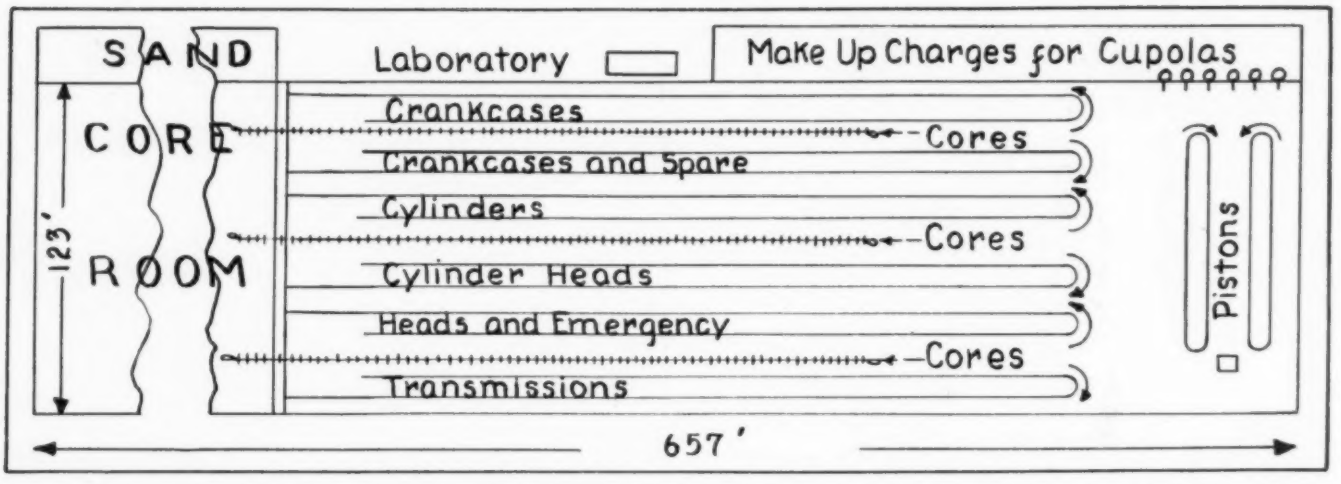


Fig. 5—General Layout of the Foundry Floor Showing the Relative Position of the Cupolas, the Coreroom and the Eight Molding Units on Which Castings Are Poured Continuously

shop in 1927, an interesting feature and one in which the participants take a legitimate pride.

The engineering staff of the Buick company designed and supervised the erection of the building and the installation of the equipment. In some instances standard pieces of equipment were changed slightly, while in others extra attachments were added to meet special conditions or to insure faster and more efficient operation. Finally, instead of starting with a rush and a flourish of trumpets, the foundry was eased into production, quietly, gently, a little at a time and

Fig. 6—One of the Shakeout Stations Where the Flasks Are Returned to the Molding Station and the Castings Are Attached to a Traveling Cooling Conveyor 4½ Miles in Length

no intention was entertained of driving it at top speed for several months after the opening.

Men in charge of operation hold to the sensible view that a large and elaborately equipped foundry has many more bearings than an automobile and yet no driver in his senses, certainly no owner-driver, would attempt to drive the first 1000 miles at the highest speed of which the motor is capable. Each moving unit in the foundry was tried out separately under load and in its relation to other units, before any attempt was made to produce castings. In fact the shop is so large that some time will elapse before it is completely utilized. In that manner the burden will be taken up gradually without a shock or a jar to the operating mechanism. A month after the foundry started, the daily heat was up to approximately 250 tons distributed between cylinders, cylinder heads and pistons made on three out of the eight available conveyor units.

Desire to reduce manual labor to a minimum was one of the basic factors taken in consideration in planning the new foundry. This idea in turn was due to a belief on the part of the management that in this present age and in a highly specialized industry, heavy drudgery and heavy manual labor on the part of the employes should not be necessary. Professional managerial pride prompted a desire to show the world that with proper equipment, the castings could be turned out not only in immense volume, but in a manner of speaking with a certain degree of ease and grace. This foundry was to offer as great a contrast to the old toilsome hand operated shop as one of the company's master models in enamel, nickel and plush bears to an old time lumbering, squeaking ox cart or to a Canastota wagon that brought the early settlers over the Alleghenies.

Why should the foundry not be raised to the plane occupied for many years by the machine shop and the assembly departments? Workmen in those departments are not burdened all day lifting and dragging heavy loads. If loads can be handled mechanically with greater speed and ease in the machine shop and other industrial establishments, it seems logical to assume that they can be handled the same way, in an equally satisfactory manner in the foundry. Apparently the General Motors Corp., is satisfied it can be done. What perhaps is more significant, it is backing the belief to the extent of $6,000,000.

Save on Labor

Altruistic motives are highly commendable. Combined with a method for cutting the payroll substantially, while at the same time increasing production, they constitute an irresistible argument. While a complete set of actual figures is not available, some idea of the saving effected in daily operation may be gained from a few typical instances. The charging crew of two cupolas melting 250 tons of iron per day consists of a craneman, an industrial truck driver on the

ground floor and two men on the charging floor. Three power conveyors bring all the cores from the coreroom to the various molding units, thus dispensing with a flock of trucks and truck drivers and incidentally avoiding the congestion occasioned by loading, unloading and storing quantities of cores at the required stations. Castings are carried to the knockout and later to the cleaning room on conveyors, thus eliminating another battery of trucks and a small army of truck drivers.

With a few exceptions, no loads around the foundry are lifted or trucked. Practically everything movable is handled by a mechanical conveyor of some kind. The human element only touches the materials here and there in transit. Sand is brought to the molder. All he has to do is pull a lever and his flask is filled from an overhead bin. Compressed air jolts and squeezes the sand in the flask. A crane picks up the mold and places it on a power conveyor which carries it first to a point where it is cored and later to a point where it is filled with molten iron.

Iron from the various cupolas is distributed to the pouring stations by a number of electrically operated cabs suspended from a monorail system. Each cab carries a driver and a 1500 pound ladle. The driver lowers the ladle in front of the cupola spout, but raises it to a height of approximately 8 feet above the floor before starting on the journey to or from the pouring station. At this height it clears the head of any workman who inadvertently may be in the vicinity at the time a ladle is passing.

For clarity of presentation, description of this foundry has been divided into several sections. This, the first, deals with the major features in a general way. Others to appear later will take up in detail equipment and methods of operation on the molding floor, the melting department, the coreroom and the cleaning division.

The Buick plant in Flint, Mich., with nearly 30,000 employes occupies the greater part of a 202-acre tract of land nearly half a mile in width by a mile and a half in length. Originally the tract was on the outskirts of Flint, but in the past 10 years during which time the population of the city has jumped from 50,000 to nearly 150,000, the plant has become entire-

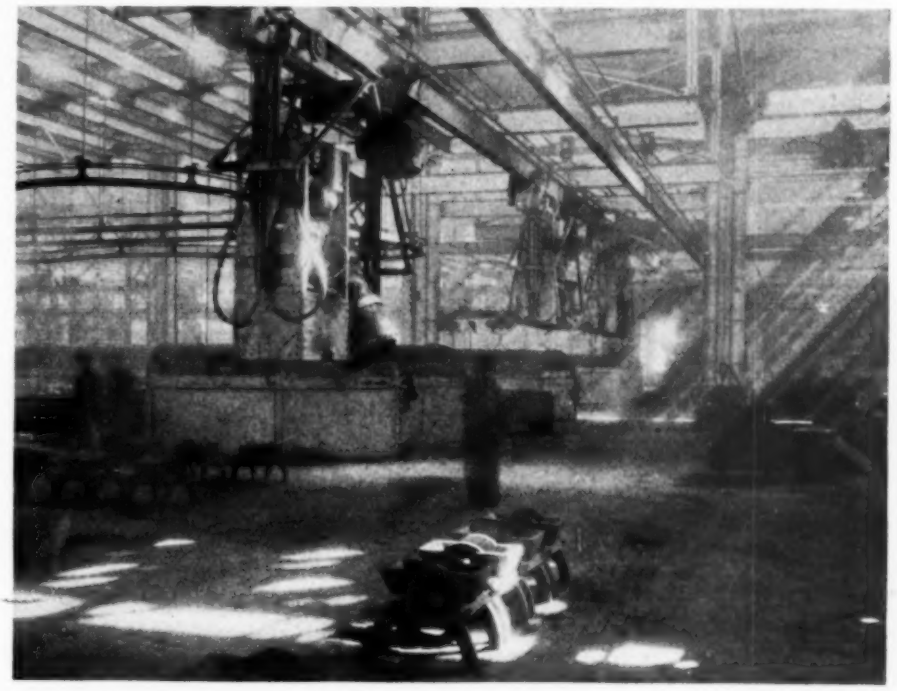


Fig. 7—Electric Traveling Hoists Bring the Molten Iron from the Cupola to a Point Close to Each of the Pouring Stations Where It Is Transferred to One of the Smaller Hand Tipped Ladles Shown in Fig. 3

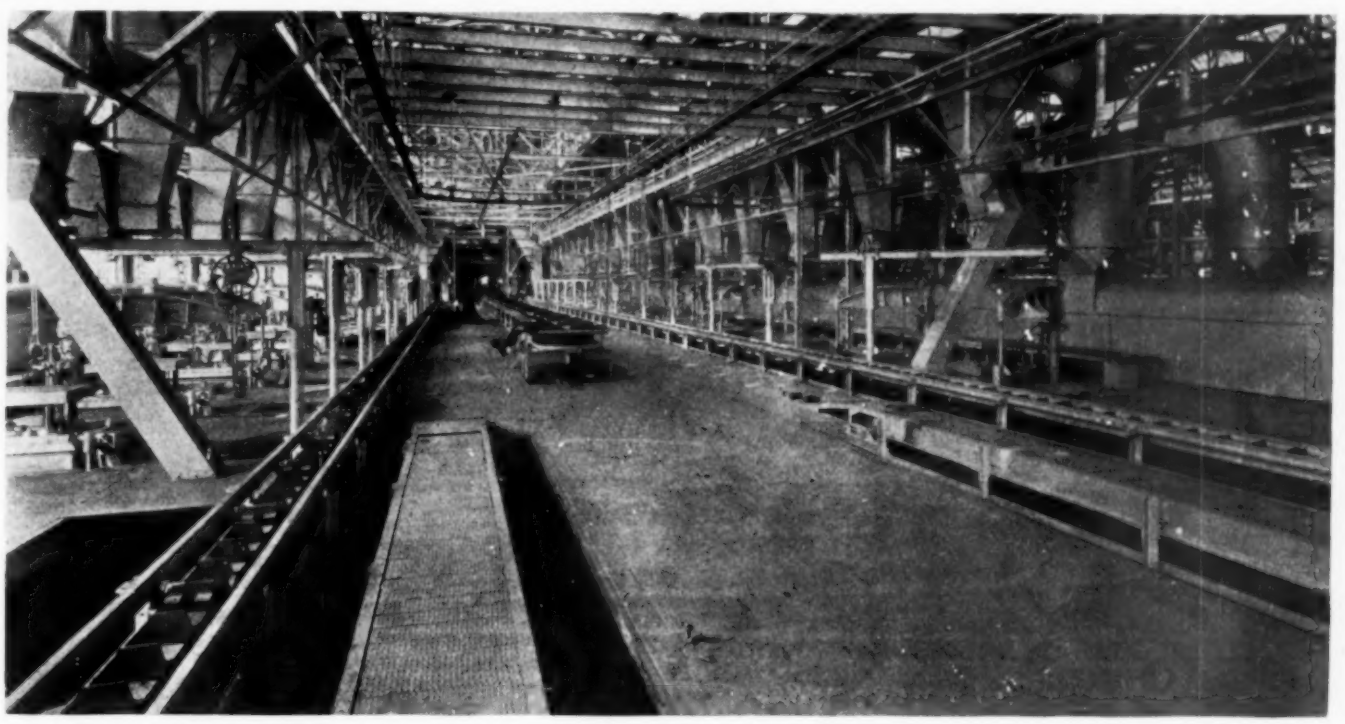


Fig. 8—General View of One of the Main Aisles Between Two Units. The Core Conveyor Is Shown in the Middle Distance. Pouring Platforms in the Foreground Are Designed to Travel at the Same Speed as the Mold Conveyors

ly surrounded by an inhabited area. Seventy-one buildings with an aggregate floor space of 5,244,609 square feet occupy both sides of a wide main street with short streets cutting across at periodic intervals. Due to an almost constant program of expansion since the plant was established, the greater part of the tract of land now is occupied.

One of the few remaining areas was utilized for the location of the new foundry with its accessory departments, stockyard, coreroom, cleaning room and combined office, stock room and repair shop. The group of buildings was erected close to the plant main street, half way between the original gray iron foundry and the nonferrous foundry and about a mile north of the main office. Development of the plant has been based on a natural flow of material from the raw state to the finished product. Flow of this material is from the north to the south and the new foundry is located near the north end of the plant. An extensive interplant system of railroad sidings connects various departments with the Pere Marquette railroad.

Buildings in the new foundry group include a combined foundry and coreroom, 123 x 657 feet; a cleaning and shipping room, 240 x 680 feet, extending parallel to the foundry building from which it is separated by a concrete paved driveway 30 feet in width and a combination office, stockroom and repair shop, 161 x 201 feet, located across the south end of the foundry building from which it is separated by a paved roadway and to which it is connected by two covered bridges. Smaller individual structures include a laboratory on the east side of the foundry and a small open building at the north end where the cores are knocked out of the castings. The sand storage and facing building and the building housing the melting activities adjoin the main foundry building at the extremities of the east side as shown in Fig. 5.

Variety in Floors

Universal trend toward utilization of daylight to a maximum extent is reflected in the extensive use of glass in the walls and roofs of the various buildings. Even the cement slab roof over the cupola annex is provided with skylights. The Pond type roof over each of the main buildings, and also the walls are composed largely of glass. The remainder of the buildings is brick with a steel frame. The roof construction favors natural ventilation and this is supplemented by an artificial system designed to keep the air clean at all times even when the shop is running to capacity and pouring iron at all eight production units.

Wood block flooring was laid on a cement base throughout all the buildings with the exception of special areas where for obvious reasons other material was substituted. A brick floor was laid in front of the cupolas and in the vicinity of the various pouring stations. Steel plates form the floor on the charging platform and on the neutral area between the foundry proper and the coreroom where the castings are shaken out and from where they start on a 4½-mile, zig-zag, 2-hour cooling journey to the cleaning room. The sand mixing department, the various passageways and the room where the cores are knocked out are floored with cement.

General layout of the foundry is shown in Fig. 5, with the core room merely outlined at the left. The three lines with the cross marks on them indicate the position of the three power driven, pan conveyors which carry the cores from the core department to the various assembling stations where the molds are cored and closed before they are poured.

Each conveyor serves two molding units and racks are provided at central points where a small stock of cores is maintained in advance of requirements. As the cores are placed in the molds, the stock constantly is replenished from the conveyor. Cores found defective in any manner or

Fig. 9—Two Elaborate and Independent, Electrically-Controlled Units Located Side by Side Are Employed for Mixing the Facing Sand. The Mixing Equipment Is Located Above, Behind and Below the Control Panel Shown

Conveyor Equipment

SOME idea of the extent to which mechanical equipment has been installed in the new gray iron foundry of the Buick Co., Flint, Mich., may be inferred from the following tabulation of conveyors and other pieces of equipment for moving material. In all 361 separate installations are listed.

Type	Number
Apron	23
Belt	27
Revolving screen	15
Elevators	22
Screw conveyors	7
Conditioners	11
Double strand chain flight conveyors	10
Reciprocating flight conveyors	8
Revolving feeders	3
Reciprocating feeders	7
Crushers	1
Single strand chain conveyors	31
Overhead monorail cranes	13
Sand cranes	2
Iron yard cranes	2
Makeup cranes	3
Coke chargers	2
Iron chargers	4
Skip hoist	1
Coke larry	1
Air pushers	105
Air hoists	20
Electric hoists	42
Sand dryer	1

cores in excess of requirements are returned to the coreroom on the same conveyor which brings them out. The pans are mounted on swivels and go around a sprocket wheel horizontally instead of in a vertical direction. After passing the end sprocket the chain and pans go down a slight incline and then swing under the chain and line of pans bearing the cores. In this manner floor space is conserved and the face of each pan remains on the upper side whether the conveyor is traveling toward or away from the coreroom. The entire installation is mounted on an incline from both ends which dips in the center under the shakeout floor after the fashion of many city streets at railroad crossings.

Molding, melting and coremaking equipment and methods in this foundry have been designed to cope with a daily heat of 700 tons. Total floor area occupied by these three departments amounts to approximately 80,000 square feet or a little over 100 square feet of floor area per ton of metal melted. In the average foundry where all the molds are made on or in the floor, the usual proportion is 500 square feet for each ton of metal melted. Conditions of course vary. In some instances the figure may be a little lower, but in stove foundries and other shops devoted to the production of light castings the proportion is much higher. In one prominent stove foundry in the Middle West, 1500 feet of floor area is utilized for every ton of iron melted. In other words production in this continuous foundry is secured on a floor area only from 7 to 20 per cent of that required in many foundries where a great number of molds are allowed to accumulate on the floor each day, before they are poured during a comparatively short period in the afternoon.

Two, power-driven conveyors shown to the right in Fig. 5 are equipped for the production of pistons exclusively in green sand molds, four castings to a flask. The castings are poured before the molds arrive at the upper turn where, as may be noted by the arrows, the conveyors turn toward each other so that the sand from both sets of molds may be dumped through a common grating on to a belt below the floor which takes it back to the rejuvenating station and thence again to the various molding stations. Castings are dropped through a chute upon a conveyor which carries them up through an opening in the pavement outside the building and dumps them into a waiting truck. Each unit has a capacity of 3200 pistons in a 9-hour day.

The remainder of the foundry floor is occupied by six conveyor molding units equipped to handle transmissions, cylinders, cylinder heads and crankcases. Other lines may be added or substituted if necessary. Two of the conveyors at present equipped to handle heads and crankcases, readily may be diverted to the production of other castings. These two units introduce a flexible feature into an otherwise somewhat arbitrary arrangement. At one period they help to take up the slack. At another they carry the extra straw that otherwise might break the camel's back.

Drag parts of the molds are made near the left ends of the various units as they are shown in Fig. 5. They are cored and closed as they move steadily toward the right. A space 30 feet in length is devoted to pouring the castings, after which they pass under a hood connected to an exhaust system which removes steam and smoke. The direction of travel of the conveyors is shown by the arrows. Thus the two conveyors on the outside turn out so that the poured castings travel back toward the shakeout stations while facing the wall of the building. The two conveyors in each of the other pairs, turn toward each other.

The reason for this arrangement is to conserve space and to get along with a minimum number of core conveyors. Study of the plan shown in Fig. 5 will show that in no other manner could three core conveyors have been distributed to six molding units.

Several varieties of molding and core sand are stored in a series of high concrete bins in a building adjoining the coreroom. This building is served by a crane and a grab bucket which take the sand out of the cars and afterward transfer the sand to the facing sand and core sand mixers located respectively at the inner end and the inner side wall.

As a result of experiments carried on at the old foundry the use of new molding sand almost has been discontinued. A small quantity of a proprietary clay, finely pulverized, is added to the facing sand and a second small amount is added directly to the sand as it is shaken out of the flasks. The bond in the sand is maintained in this manner and close supervision is exercised in insure uniform material. Usually the presence of a large amount of old core sand insures a desirable degree of permeability, but if the sand shows a tendency to *tighten up*. a small quantity of silica sand fed directly into the facing mixer, corrects the trouble.

Prepares Questionnaire

The bureau of foreign and domestic commerce of the department of commerce has prepared a three-page questionnaire intended to elicit information regarding the general condition of the gray iron foundry industry. This questionnaire is being sent to the complete list of foundries in the United States as tabulated in *Penton's Foundry List*.

Preliminary work in preparing this questionnaire has been carried out under direction of H. C. Dunn of the domestic commerce division. Information sought covers molding facilities, labor sources, capital investment, total production over a period of four years, tonnage of castings consumed in manufacturing and also that which is destined for jobbing trade. A brief analysis of castings uses is sought as one feature of this investigation.

Speaks on Furnaces

The Quad-City Foundrymen's association held its October meeting at the Davenport chamber of commerce, Davenport, Iowa, on Oct. 17. The principal speaker was W. B. Wallis, president, Pittsburgh Electric Furnace Corp., Pittsburgh, who addressed the members of the association on the use of the electric furnace in producing gray iron and malleable iron castings.

Publishes Pattern Data

The Sivyer Steel Casting Co., Milwaukee, has published a 54-page booklet describing the essential points on pattern construction for steel castings. The booklet was published for the benefit of its customers and is attractively arranged. Factors covered are construction, shrinkage, special core boxes, marking of patterns, flasks, machining allowance, finish for round holes, rapping plates, standard colors for pattern painting, etc. The back section of the publication is devoted to terms used in the steel foundry.

Purchase Plant Control

A. P. Van Schaik and W. F. Wheeler, American Chain Co. Inc., Bridgeport, Conn., have purchased control of the Ford Chain Block Co., Philadelphia, and have reorganized and reincorporated the company. Mr. Van Schaik becomes president, W. F. Wheeler, vice president and G. E. Sullivan, secretary. Mr. Van Schaik and Mr. Wheeler will continue with the American Chain Co.

Who Can Solve the GRAY IRON PROBLEM?

Consumption of Many Commodities Has Outstripped Production Gain—Steel and Malleable Show Quarter Century Rise—Has Gray Iron a Brighter Future?

By DAN M. AVEY

ABILITY of America to take up and absorb the products of every class of industry—to develop new tastes and new habits, to utilize new conveniences and finally, to pay for them, is the wonder and envy of the entire world.

Were different persons asked to assign the economic reasons back of this American industrial phenomena as many answers would be received as individuals to whom the questions were addressed.

Capital readily asserts that all of this would not be possible were it not for the ample supply of available funds, for the fluidity of credits and for the readiness of American capitalists to venture their funds in untried enterprises.

Management without doubt would assume its full share of credit. Efficiency would be the answer. Management has shown how to produce in such quantites that plenty characterizes everything in America.

Labor would affirm that it is only through continued application, the ready acceptance of new methods and ability and intelligence of the American workman that all of this has arisen.

The development has been due to all these factors, to high wages and to the ability of our own artisans, craftsmen and clerks, professional men, business men and farmers to produce and afterwards to use what is made in America.

During the American Foundrymen's convention in Detroit last year representatives of ten or 12 different European countries were amazed at America's high-speed production, at the untold quantities of goods made in this country and at the ability of our people to absorb them.

A German who stands at the forefront of one branch of the foundry industry in his home land said: "Everybody here buys automobiles. Your workmen pay for them in 300 to 400 hours of work. Our workmen must give 3000 to 5000 of their hours before they can own an automobile."

He saw only the prevalence of high wages and failed to appreciate the greater production, the multiplying of human effort which is possible in this country. American labor has been fortunate in its high scale of wages. Give it credit also for a high order of intelligence which instead of resisting the installation of machinery which reduces the required number of men, has co-operated in practically all cases.

Machines Aid

The intelligent American workman realizes that whenever a machine is introduced which does away with the necessity for eight out of ten men employed on a given operation, it does not necessarily mean that the eight will starve. They in turn produce something else at a low cost which may be used for the benefit of all ten. Labor-saving equipment, the application of electrical and mechanical power to save the human back, the adoption of standard articles which can be produced in quantities all have had a marked effect in the first quarter of the twentieth century.

With the increase in number and variety of manufactured articles the foundry industry vitally is interested. Whether it be in the article itself or in the machinery required for its production, foundry products are a basic requirement. From the steel wheel of the cross-country motor truck or bus to the fine gossamer of silk that covers the most insignificant armature coil, castings play a prominent part.

Just how has castings production been affected by American industrial and mechanical expansion? Have foundries taken full measure of their reward in increased business?

Since 1900, the ability of the country to consume products made of iron has grown faster than has the population of the country. Considering the first 25 years, in 1901 we had 77,612,000 people and in 1925, 113,493,000 people. Our population has grown 46 per cent. In 1901 the pig iron output which, of course, does not represent the consumption of that year, but is a measure of the requirement, was 15,878,000 gross tons. In 1925 the production of all grades of pig iron was 36,530,000 tons, giving an increase of over 130 per cent when only the two extremes of the scale, that is, 1901 and 1925, are considered.

Perhaps a fairer basis of comparison may be found by reducing these figures to a common measure, and considering the production of pig iron per capita. In 1901, 458 pounds of pig iron were produced for each person in the United States. In 1925 this had grown to 720 pounds.

Consider for a moment the first quarter century divided into five periods of five years each. This affords a convenient method of comparison, since the War period, including from 1916 to 1920, falls within one block and may be considered in the light of the tremendous demands of that time. The last five years, from 1921 to 1925, embraced the greatest depressions of the century and also one of the peak years.

The average per capita production of all classes of pig iron for the various five year periods are as follows:

Years	Pounds
1901-1905	507
1906-1910	604
1911-1915	638
1916-1920	801
1921-1925	612

The comparison of per capita con-

sumption of pig iron for each year is shown in Fig. 1.

Castings made from ferrous metals naturally fall into three main divisions, that is, steel, malleable and gray iron. Of course, gray iron castings are patriarchs of the foundry industry, but in this discussion gray iron castings will be considered last.

Compile Statistics

Steel castings receive complete and satisfactory attention from the compilers of statistics. The American Iron & Steel institute gathers figures on production and prints them at intervals. Accordingly, it is easy to ascertain that in 1901 the total production of steel castings was 318,570 tons while in 1925 a total of 1,253,786 tons of steel castings were produced. Regarding the first and last five-year periods as in the case of the pig iron statistics, the production has grown from an average of 406,149 gross tons in the first period to 1,085,164 tons in the last. The last period includes the notoriously bad year of 1921 and also 1923 which was a record for all time in the production of this foundry commodity.

Reducing this series of statistics to a per capita basis, the average production and probably approximate consumption of steel castings per capita in the various five year periods is as follows:

Years	Pounds
1901-1905	11.2
1906-1910	17.5
1911-1915	19.5
1916-1920	27.9
1921-1925	21.9

The growth in steel castings output by individual years is shown in the accompanying Fig. 2.

The malleable industry is not so fortunate in possessing complete statistics on production. For the past three years the department of commerce has compiled a complete and interesting report of monthly bookings, production and shipment, but these do not go back far enough for present purposes of comparison. Accordingly, an estimate has been made which has as its basis known outputs and other totals which are computed.

These figures start with 1914 when a total of 422,000 tons was the estimated output of malleable iron castings. In 1925 this had grown to the surprising total of 931,000 tons. This is greater than the department of commerce total which is given as 737,532 tons for that year. However, this report of the department of commerce includes 139 of a total of 214 malleable foundries. One or two of the large establishments and a number of the smaller ones, do not contribute to the information which the department compiles. However, it is known that approximately 81 per cent of the malleable capacity of the country reports to the department. Furthermore, the rate of operation is known and this permits a fairly accurate estimate of the output.

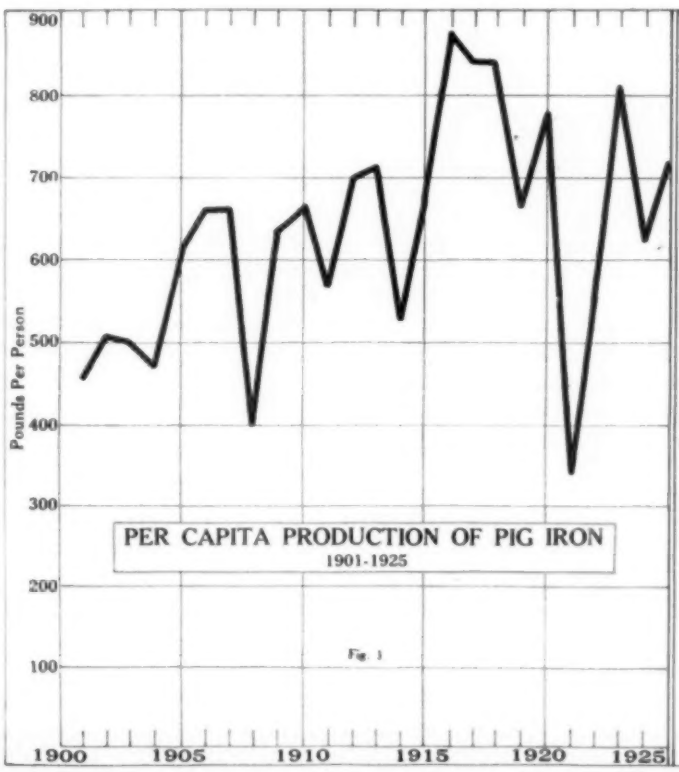
The government's figures on the rate of operation in the malleable industry have been criticised. It is shown in the department's compilation that the malleable castings business in this country for the past several years has been operated at only about 45 to 60 per cent, and they have been in this neighborhood for a considerable period. However, it must be remembered that the department's basis for this percentage calculation is a formula based on molding space, production per molder per unit of floor space multiplied by the actual working days of the month. Experience has shown that this gives a percentage of operation lower than an actual capacity figure would yield.

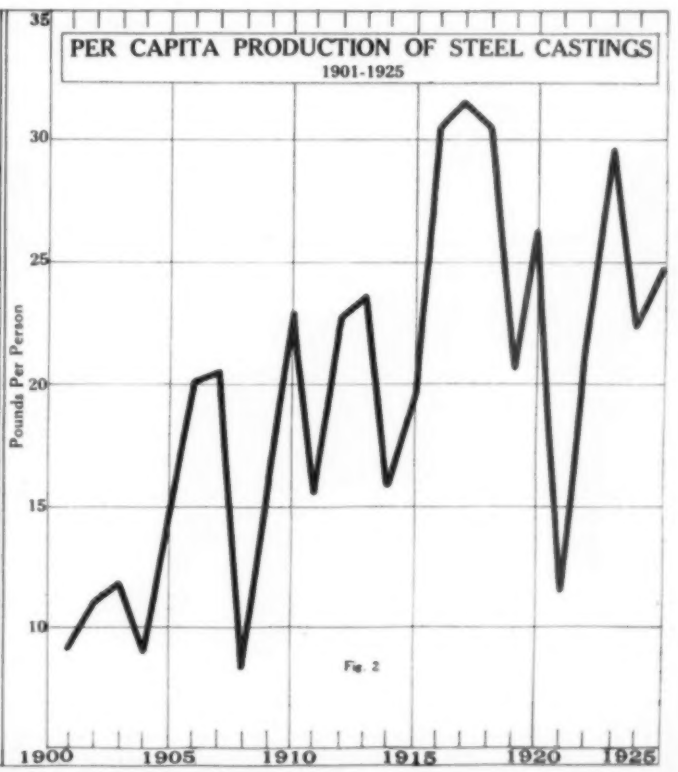
Fig. 3 shows the output of malleable castings in pounds per capita during the years 1914 to 1925, inclusive.

Accurate Data Lacking

Proceeding next to the case of gray iron castings output, we find much less in the way of dependable statistics. In fact, no statistics are available which will give an accurate measure of the total output of gray iron castings.

Perhaps the comparison of the activity in this branch of the industry may be gained from the American Iron & Steel institute figures on the production of foundry iron. Obviously, this will not take into account the amount of iron or steel scrap which goes through the cupola nor will it account for castings made from mixture of other grades and types of iron than that roughly grouped under the general heading of foundry iron.





However, it is doubtful if the great majority of the gray iron foundries, particularly those which add their thousands of tons per month to the output, use a great tonnage of pig iron other than that classified as foundry iron in their straight foundry mixture. In making this statement, consideration is given to automobile shops which in some cases use as high as 25 per cent of pig which is classified and listed as malleable iron. Even the Ford Motor Co. with its estimated 2000 tons per day and the General Motors at its Saginaw Products division with its 600 tons per day; Buick with 750 tons etc. could not make an appreciable difference in this estimate which runs into the millions of tons.

Foundry Iron Basic

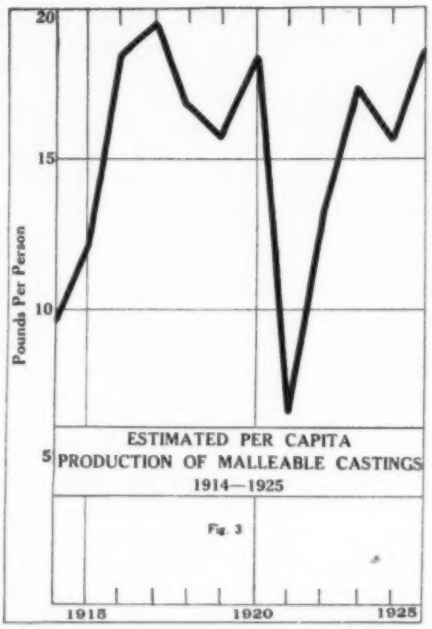
On the other hand, the pipe foundries should be considered as large tonnage units using foundry iron without the admixture of other grades and with only a limited amount of scrap. The annual pipe capacity of the country is not available, but the output gives, for 1925—1,414,252 tons of pressure pipe and 510,483 tons of soil pipe. Thus it will be seen that the pipe industry plays a considerable part in influencing the total gray iron castings output of the country.

Starting again with the quarter century lineup, in 1901 a total of 3,548,000 gross tons of foundry iron was produced and probably the greater part of this may be considered as having been turned into gray iron castings. In 1925 this had grown to 5,410,000. Reducing the various tonnage figures to this same basis of output per capita in pounds, the average production estimated from this source for the five year periods mentioned is as follows:

Years	Pounds
1901-1905	112
1906-1910	121
1911-1915	112
1916-1920	116
1921-1925	97

Fig. 4 shows the vicissitudes through which the foundry iron output has gone.

Unfortunately, it is not possible to secure and present per capita production charts showing those products which have been and which continue to encroach upon the foundry field. Of course, a certain measure of competition exists between the various cast ferrous products listed. Malleable castings in some cases have displaced steel castings, steel castings in other instances have found favor over malleable and both of these have played merry little games on gray iron castings. However, the main factor of extreme competition has been found



ESTIMATED PER CAPITA PRODUCTION OF MALLEABLE CASTINGS 1914—1925

Fig 3

entirely outside the foundry industry. Rolled, drawn, stamped, forged and welded products, parts and devices have been offered and in many cases successfully placed in service instead of castings.

Two Have Gained

Despite these outside encroachments, as may be noted from Figs. 2 and 3, malleable castings and steel castings have maintained a gain and have shown a growth in the first 25 years of the century. Gray iron castings, if the production of foundry iron is a measure, apparently have not quite held their own.

Perhaps the reason for these conditions may be found in a comparison of the types of business organizations and business practices, followed in the various castings fields.

Steel castings manufacturers in practically all cases have grown into the business through compartively large organizations. In fact, the majority of steel foundries are sizeable organizations as compared with the majority of gray iron foundries, referring now to the amount of capital required to build and operate a steel foundry rather than to the actual number of men employed. In fact, while some small steel foundries are in successful operation with a capital of perhaps $100,000 it generally is agreed that the capital required is from 60 to 100 per cent of the normal annual sales. That would mean that the foundry making and selling $600,000 worth of castings a year necessarily must have a capital approximately of that amount. At the same time the margin of profit in this businss has not been so attractive as to bring adventurers into the steel foundry industry.

Consider next the malleable foundries. Most of these are rather extensive establishments. Many are departments of large implement or machinery manufacturing concerns and still others have their limited number of customers among the large corporations. It would be difficult today to start a new malleable foundry with less than $500,000 and $750,000 capital. This would be the approximate spread for a plant which would have have two air furnaces and would produce probably 6,000 tons a year at capacity. In this case, also, the capital investment is turned over only about once a year at the present state of prices.

Small Time Competition

Among gray iron foundries, excluding those giants which have sprung from the automotive field, the various chains of radiator and sanitary ware shops and pipe foundries, it does not take an exceptional amount of capital to get into the gray iron castings business.

This is not intended to cast aspersions on the thousands of really substantial small gray iron foundries, but still it is not uncommon to find an exceedingly small shop competing for gray iron castings business. In other words, the actual capital required to get into the gray iron castings business is not heavy.

Organizations of larger capital are more disposed to see the need for the best of equipment and facilities. The malleable industry, when it found the quality of its product attacked had the business judgment and the financial ability to solve the problem. No one questions the ability of the modern malleable foundry to make a high quality product.

Twenty years ago the quality of malleable castings was open to question. Claims were made which seldom were supported by the quality of product furnished by malleable manufacturers. Worst of all, a lack of uniformity made it impossible for a customer to tell just what he would receive when he ordered high quality malleable iron. In consequence a prejudice arose in the minds of those specifying malleable castings and to combat this growing indifference if not active opposition, the manufacturers of malleable castings formed an association, developed a thorough research on the qualities of their products, wrote new specifications and revised standards for those existing and then proceeded to police their own backyards. In other words, the American Malleable Castings association, now the Malleable Iron Re-

search institute, has established its own rules of procedure and has found means to assure that its members comply.

The same condition applies to a large measure in the steel castings industry. Here quality has had every attention and has benefited from research and investigation.

Among gray iron foundries, hampered in general by competition from within and without, limited in means to bring about advances, few real improvements have been made and these have not been broadcast to the world.

The organization idea, particularly as applied to trade associations, has grown by huge strides in the past few years. Of course, in this country any group of manufacturers is confronted by the bogey of anti-trust and restraint of trade legislation.

However, the trade association can be made a unique factor and perhaps, properly applied, can set the feet of the gray iron industry again upon the upward path. The government does not frown upon any trade association activity which does not directly act in restraint of trade. Secretary of Commerce Hoover has said that the trade association is one of the greatest contributors to the general uplift and progress of American industry in recent times. The purpose and aim of a trade association should be to deal with all general questions applying to the industry it serves. It should develop efficiency and economy; compile and distribute statistics; establish trade standards and co-operatively handle problems common to the production or distribution of a commodity. Under these headings wide latitude is permitted.

For example, it is not beyond reason to conceive of a gray iron group or series of co-operating groups to deal with the question of quality of product. Perhaps this phase might be handled by existing organizations. Research might be conducted which would remove some of the defects rightly or wrongly assigned to gray iron castings. Great development work might be possible in alloys, special heat treatment or other technical phases that would assure uniformity.

Under the heading compiling and distribution of information, a simple check might be had upon buying materials. Purchasing agents of member companies might come to rely upon the reports of stocks on hand and purchases made to govern their own future requirements.

The establishment of trade standards already has been found advisable by practically all of the local foundry organizations in this country.

That phase of organization activity which has to do with handling problems common to an entire industry or branch of the industry means today the study of costs more strongly than any other one feature. More attention has been given to foundry costs in the past few years by local and national associations, but much latitude is left for future study and growth. The application of uniform cost finding methods and the comparison of results by an impartial agency would be valuable.

More than 125 trade associations have adopted standard cost systems. Many of these have stopped at this point, but a few have the added feature of comparison.

E. W. McCullough, manager of the department of manufacture of the chamber of commerce of the United States, in a paper presented at the Detroit convention of the American Foundrymen's association, says:

"A cost system which in its operation fails to find and eliminate waste and expedite production should not be called a cost system, today. I am not unaware of some of the conditions in foundry work which make it more difficult than in some lines to operate a cost system and secure the co-operation of the shop men, but I know of none which create an impossible situation. When everyone having a part in using a cost system realizes that in co-operating he is both advancing his own interests and that of the business he is engaged in difficulties disappear.

"In every mention I have made of cost accounting I am referring to uniform cost accounting, which is the only kind which should be used by a group of manufacturers making the same commodity. By uniformity I mean uniform principles and using uniform methods whereby all in the same line include the same elements in their cost calculations—this permits cost comparisons between competitors or the members of an association and has been pronounced legal if the purpose or results of such comparison are not used unlawfully."

Co-operation along the lines of distribution is not yet practical from a foundry standpoint although some large interests such as the mail order houses have in effect tied together a string of foundries so that they can produce commodities near the point of distribution. An example is furnished by large mail order houses which have perhaps a dozen different foundries producing the same type of stoves in different parts of the country. These are shipped on order from the foundry nearest at hand. It is conceivable that foundries manufacturing a complete commodity might form some sort of a co-operative distribution scheme, develop national merchandising plans and thus avail themselves of a reduced unit cost in selling.

Gray iron castings in no manner of means have served their ultimate destiny in promoting the comfort and happiness of mankind. Their place is too valuable for that; but they will be better made, better sold and at a better profit through some form of co-operative effort.

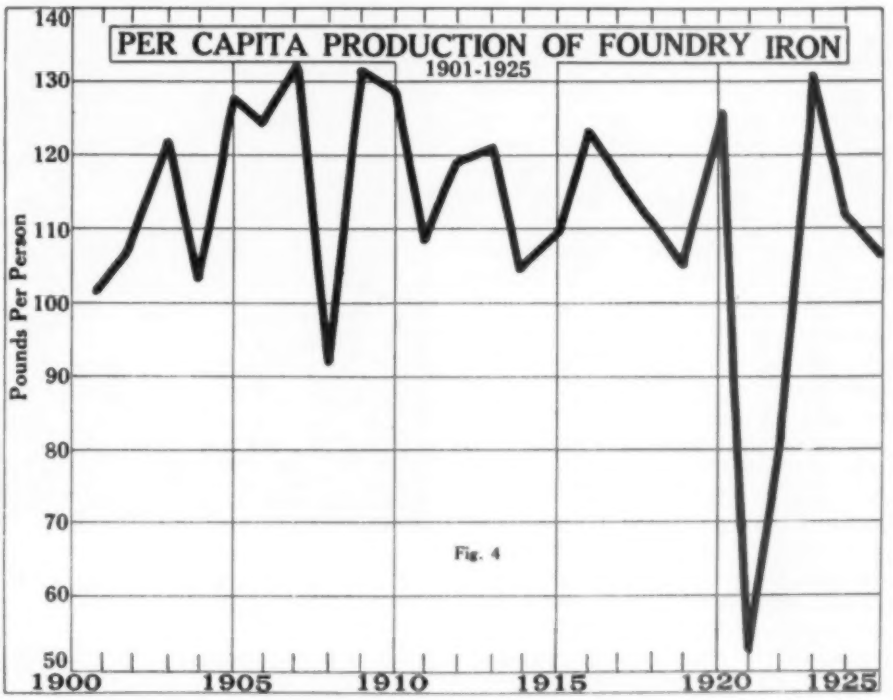


Fig. 4

Metal for

MALLEABLE IRON FITTINGS Melted in the Cupola

By L. E. Gilmore

IN THE manufacture of malleable iron fittings the cupola is predominant as a melting medium. The reason for this is that the cupola has certain decided advantages for the production of fittings. In addition to a cost materially less for molten iron, the cupola has the peculiar advantage, not possessed by other furnaces of being readily adaptable to methods of continuous operation, whether using large or small tonnages.

This is of great importance particularly in foundries using continuous molding methods where molds are placed on conveyors, poured, dumped and the sand reconditioned and returned to the molders. This effects great economies in space, with standardized conditions controlling materials and speed of production. Moreover, cupola malleable has two additional advantages from the viewpoint of quality. Cupola malleable fittings are less susceptible to embrittlement in hot galvanizing than the lower carbon malleables from other furnaces. They also are less liable to leakage, requiring less elaborate methods of gating and feeding.

Due to higher carbon inherent to cupola melting, that is, carbon about 3 per cent, the tensile strength and elongation of cupola malleable is not as high as that of properly made malleable from other types of furnace. However, under suitable control cupola malleable will run from 40,000 to 50,000 pounds per square inch in tensile strength and from 6 to 10 per cent elongation in 2 inches. This strength and ductility allows ample safety factors for all services where malleable fittings are applied.

Cupola malleable is not recommended for general jobbing castings, but is entirely suitable for thin sections such as the general run of malleable fittings, and for castings of similar sections as shown in Fig. 1. When cast from cupola iron the heavier section fittings, say 6 inches and up, should be cast in chill molds to have all the carbon combined in the white iron casting. Incidentally

L. E. GILMORE
—follow-up of operations must be constant and unremitting

the chill mold also insures a tight non-leaking fitting with a more finished surface.

Production of the desired quality in cupola malleable requires careful control over such items as: Details of cupola construction and daily preparation; blast used; quality and quantity of fuel; raw materials; mixtures; control of sands for molds and cores; details of annealing operation such as type of oven and fuels used, and the effect of temperatures, time and rate of cooling.

Cupola builders produce fairly standard furnaces of various sizes with ample tuyere openings, and there are a number of suitable blowers on the market both pressure and fan, to meet any desired conditions. Only the lower row of tuyeres on a cupola should be used, as the upper row serves no useful purpose and not only makes it necessary to raise the bed higher but also may cause undue oxidation. A cupola somewhat larger than immediate requirements may be lined down readily to a smaller diameter. If a melt of 4 to 4½ tons an hour is desired, a 3-foot inside diameter is about right, while for 18 or 19 tons an hour about a 70-inch inside diameter is required. Owing to the high bed which is necessary for the extremely hot iron required to run thin malleable sections, a considerably greater quantity of fuel is required and a consequent slowing up in speed of melting results, as compared with gray iron cupola practice.

As to the height of tuyeres above the cupola bottom, 18 inches has been found suitable with the slag hole about 13 inches from the bottom. This is good practice whether using a 3 or a 6-foot inside diameter cupola. The shell lining ordinarily is made up of two rows of cupola blocks or one row of cupola blocks with one or two rows of suitable fire brick inside. Daily repairs to bring the lining back to the original straight lines are made, using fire brick or mica schist set in with a mixture of one-third fire clay and two-thirds silica sand or ganister.

A good finish for the spout on top of the brick lining is a mixture of one-third fire clay and two-thirds silica sand. The bottom, 9 to 10 inches deep, sloping toward the tap hole, can be made of molding sand, finished off and tamped in with a similar mixture of fire clay and silica sand. Probably the most satisfactory breast is the 2-hole fire brick block which can be obtained from the brick manufacturers. One hole ordinarily is kept stopped up throughout the heat unless the hole in use becomes too large. Blast pressures in ordinary use are from 8 to 16 ounces but may at times run somewhat higher.

It is desirable to ream the tap hole to a size that lets the iron flow out at the same rate at which it melts. In this way a fairly constant height of iron can be maintained inside the cupola with the slag running continuously and with infrequent stopping and opening of the tap hole. A cupola properly prepared and operated can be run all day, melting iron at the

same rate and of the same quality at the end of 9 or 10 hours as at the start.

A 3000-pound tilting teapot ladle in front of the tapping spout will produce uniformity in the iron by acting as a mixer, in addition to the mixing which takes place in the molten iron retained inside the cupola.

Iron Must Be Hot

To produce good fittings, the iron must be extremely hot to pour the thin sections, and the chemical composition of the iron must be such that all the carbon will be in the combined form as cast, and in such combination that the white iron casting can be annealed to produce a good black heart malleable.

Hot iron for malleable means iron clear hot in the ladle with no sign of cooler iron floating on top. The melting of such iron is more dependent on one item of control than on all other possible variables and this item is the height of the bed above the tuyeres and the constant maintenance at that proper height. As compared with gray iron practice this is high. It has been found in practice that, depending upon blast pressure and volume, a height of coke above tuyeres of 41 to 51 inches will melt good hot iron.

For hot melting, small thin charges are better than large ones, 1000-pound iron charges for a 3-foot inside diameter and 3000-pound charges for a 6-foot cupola are about right. Fluctuations in the height of the bed should be kept at a minimum. In some cases it has seemed advisable to start with a few lighter iron charges followed by full size charges which are then maintained constant throughout the heat. However, uniform charges throughout should give satisfactory conditions.

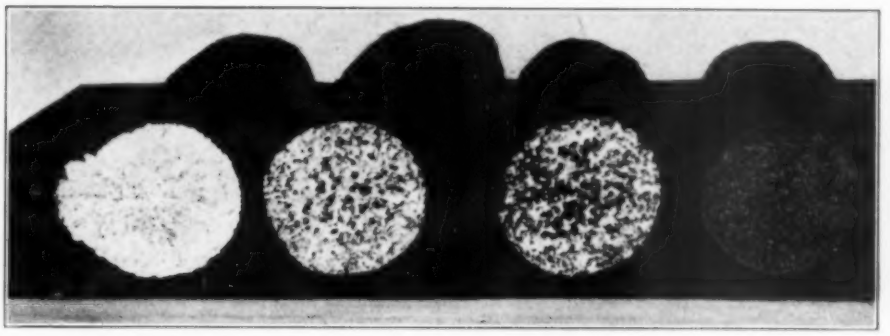


FIG. 2—HARD IRON CONTROL BARS. FIRST BAR ON LEFT IS HIGH IRON FOLLOWED BY A NORMAL MOTTLE. NEXT BAR IS ON LOW SIDE AND LAST IS TOO LOW

For melting hot iron, the most economical use of fuel between charges is a ratio of one part by weight of coke to six parts of iron or a little better. With a ratio of 1 to 7 the iron would not be hot enough for some thin sections. Saving coke at an expense of misruns is poor economy. By-product coke is considered the best cupola fuel. It usually has a harder, less friable structure than beehive coke and is readily obtainable with sulphur under 0.85 per cent and ash under 8 per cent.

Slagging the Cupola

Limestone, or dolomite broken to 2-inch size, is used generally to slag the cupola. About 15 to 20 per cent of the weight of coke in limestone will make a slag fluid enough to flow readily through the slag hole. Fluorspar in small amounts often is added with limestone or dolomite, as the fluorspar has a lower fusion point and makes the slag more fluid. However, limestone alone when used in sufficient quantity will make a good fluid slag.

An intelligent, alert man in charge of cupola operation is a most important factor in cupola control and will save many a dollar. Should the iron show signs of a drop in temperature or the hard iron test plugs show a tendency to *high* (white) or *low* (gray) iron, a prompt addition of extra coke in the former case or a shift in mix to meet either of the latter conditions will produce the proper iron. Attention to the slag hole and the fluidity of the slag is also essential.

Raw materials used for cupola malleable iron charges are sprues, malleable scrap, steel, pig, spiegel and ferrosilicon. Under normal conditions of operation the sprues consisting of gates and risers from the foundry will be remelted. This may comprise up to about 50 per cent of the charge depending on the size and type of castings made. The relative proportions of malleable scrap, pig iron, and steel can be adjusted to accommodate the variations in market prices for these materials. For the average malleable bessemer pig, at least an equivalent amount of steel of suitable charging size ordinarily is required to balance the silicon in the pig. Sufficient spiegel, usually between 15 to 30 pounds, is added to raise the manganese to the desired percentage. If the silicon of the mix is less than desired, it can be raised readily by adding ferrosilicon; the 50 per cent silicon is in convenient form to use.

TYPICAL CHARGE

Material	Per-Cent
Sprue	40
Malleable scrap	20
Pig (malleable bessemer)	20
Steel	20
Spiegel	0.75

In making up a mix for cupola malleable, under normal conditions of operation, changes in composition may be allowed. Melting loss in silicon usually will average 0.10 to 0.15 per cent, and in manganese from 0.15 to 0.25 per cent. Phosphorus remains

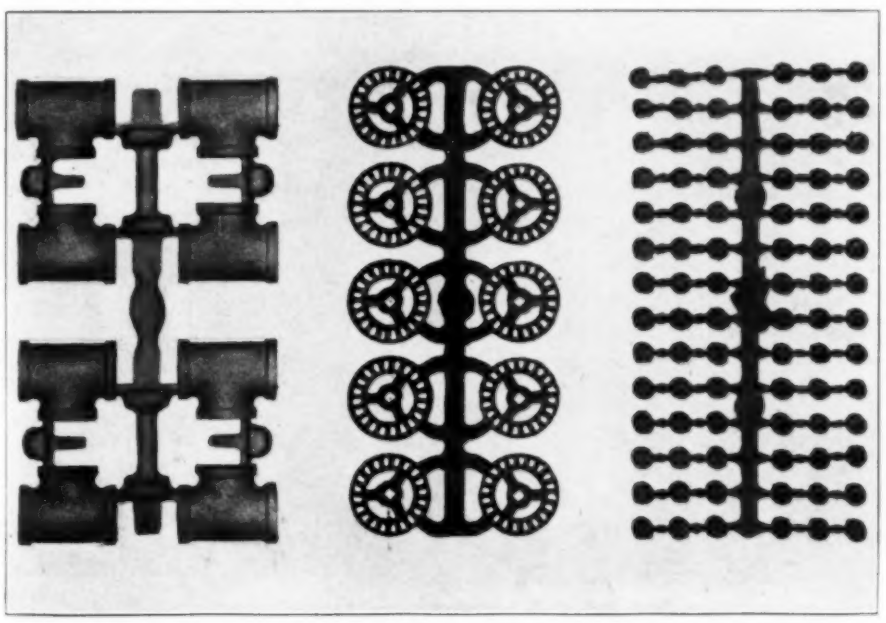


FIG. 1—TYPICAL CASTINGS MADE FROM CUPOLA MALLEABLE CAST IRON

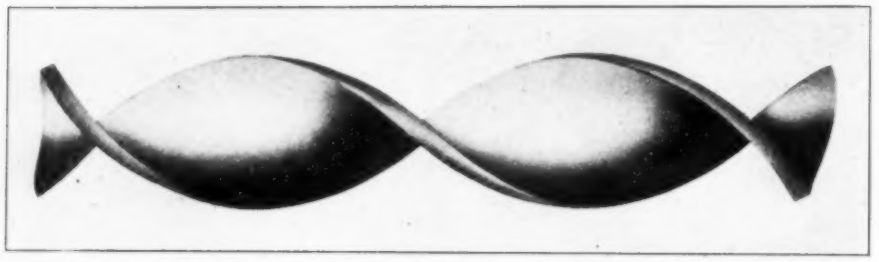


FIG. 3—TORSION BAR TWISTED TO SHOW QUALITY OF CUPOLA MALLEABLE CAST IRON

practically as charged. Sulphur will increase about 0.06 to 0.12 per cent as the molten iron comes in contact with the coke. If desired, some of this sulphur addition may be eliminated by treating the iron in the ladle with soda ash or caustic soda which are sold in convenient form for use under various trade names.

Contact of the molten iron with coke also controls the carbon of the melted iron. No matter what the carbon of the mix, the iron becomes saturated with carbon for the conditions of melting and temperature in the cupola. This results in a nearly constant carbon percentage of about 3 per cent—2.90 to 3.20 per cent is the usual range. With the above facts in mind in regard to changes in composition taking place in the cupola, the mix may be manipulated to produce in the ladle the composition desired to produce quality in the finished casting.

To produce a chemical composition in the hard white iron that will make good cupola malleable after suitable anneal, requires a balancing of manganese with sulphur, and of silicon with carbon. Provided the raw materials are within malleable limits in phosphorus, under 0.200 per cent—that element may be forgotten. However, a low phosphorus is desirable, especially when the product is to be hot galvanized. As noted in a previous article, "Proper Sulphur-Manganese Ratio Must Be Maintained" in THE FOUNDRY Sept. 15, 1927, the manganese must be greater than that required to form manganese sulphide with the sulphur present in the iron. As the sulphur in cupola malleable generally is between 0.15 and 0.25 per cent, averaging usually somewhat under 0.20 per cent, manganese between 0.55 and 0.65 per cent would be ample to care for the sulphur. Of course higher sulphur may be offset by higher manganese.

Regulates Silicon

As the carbon is practically constant at 3 per cent under melting conditions, the silicon must be regulated to balance this so as to produce a hard white iron casting with all the carbon chemically combined. Any free carbon or primary graphite present in the white iron, reduces the strength and ductility of the annealed casting. No suggestion of gray iron is wanted in a malleable product.

There are three factors that will determine the amount of carbon in chemical combination in the white iron: Percentage of silicon present in relation to the carbon; the casting temperature, and the rate of cooling. With a fixed carbon percentage, the higher the silicon, the greater the precipitation of free carbon. A low casting temperature and slow cooling also aid in precipitating graphite. Such factors as thickness of section, use of chills, and dumping of molds enter into speed of cooling. Under usual foundry conditions a silicon between 0.60 and 1.00 per cent will produce good cupola malleable; the iron with silicon content under 0.80 per cent is more likely to be the stronger and tougher product. When casting in chill molds, as is necessary to combine the carbon in heavy sections, the silicon can be higher than when casting in sand molds.

As a guide for control of the condition of the carbon in the white iron casting, a 1-inch diameter bar can be cast every 15 minutes throughout the heat. Some of these bars are shown in Fig. 2. This bar, cooled under standard conditions and broken, will indicate whether or not the much thinner sections of the fittings are solid white. A one quarter mottled bar, the mottles being spots of free carbon, indicates iron with total carbon combined in the fittings as cast, and is the standard desired. An all white bar is *high* and a gray bar *low* iron.

By following any indication of change from standard in these bars with corresponding changes in the mix, the deviation from normal is corrected in later charges. Bars ⅝-inch in diameter also cast every 15 minutes throughout the day and annealed, give satisfactory evidence as to the control of uniformity all through the heat as well as indicating thoroughness of anneal. Fig. 4 shows a series of these control bars in a rack.

Standard malleable tensile test bars cast every two hours, annealed, and pulled in a standard tensile testing machine, give concrete figures on quality of product. Another good but simple test for quality is a torsion test bar, 3/16 x 1 x 6 inches. One of these bars after twisting is shown in Fig. 3. Such bars twisted to fracture in a small hand torsion machine give visual evidence as well as data on the amount of twist as a measure of ductility.

The American Foundrymen's association, in the past few years, has been fostering sand tests, and up-to-date foundries now are controlling their molding and core sand mixes

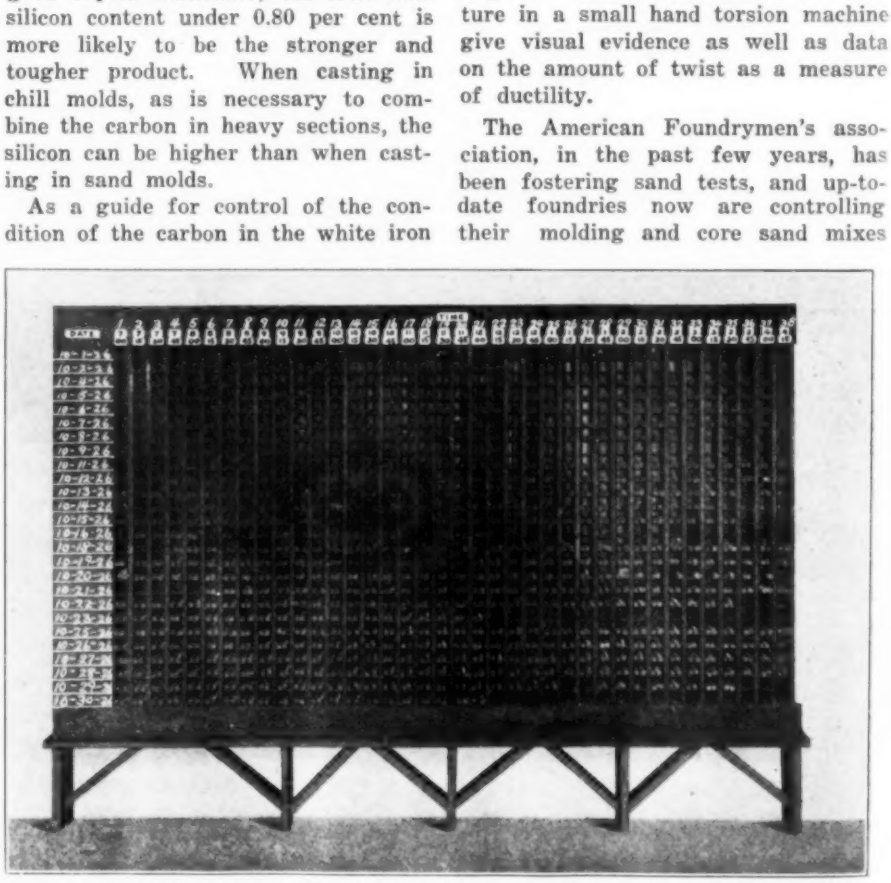


FIG. 4—RACK HOLDING A MONTH'S RUN OF BROKEN TEST BARS ⅝-INCH DIAMETER, CAST EVERY 15 MINUTES AND ANNEALED TO SHOW UNIFORMITY OF HEAT AND THOROUGHNESS OF ANNEAL

through tests on permeability, strength and moisture to the betterment of quality. In large malleable fittings foundries using continuous methods of operation where the molding sand is conveyed away, reconditioned and returned, the sand may be maintained closely to uniform standards.

Controlling Factors

Factors that control the annealing operations are the same for cupola malleable as for malleable from other melting furnaces. Assuming white iron of proper composition, the conditions to be controlled are: Maximum temperature attained; time above critical temperature, and the rate of cooling through the critical range. A higher temperature for a shorter period will cause a complete change from combined to free *temper* carbon. However, a somewhat longer time at a lower temperature may be desirable to develop the highest physical qualities.

Malleable iron has been annealed under laboratory conditions in less than 30 hours. However, under commercial conditions where considerable tonnages are to be annealed, the cycle takes several days. The controlling factor here is that the iron last to reach the critical temperature must have time to be annealed thoroughly; and then the cooling of a large mass requires greater length of time than a small quantity. An annealer of six tons capacity may complete an annealing cycle in 50 to 60 hours while a sixty ton annealer may require almost double that time to complete the same cycle. Pyrometers are used extensively to control the temperatures in the annealers.

A good scheme is to use 4-point recorders and have couples in the four corners of the oven, alternately top and bottom. This covers both hot and cold locations. Firemen should have indicating instruments at hand which can be shifted from couple to couple and from one oven to another to watch oven temperatures. The ovens should be explored thoroughly by placing couples in different locations both inside and outside stacks. In this way lags in temperature in different locations are known, and a standard cycle may be established to give uniform anneal all through the oven.

Length of the cycle is affected not only by the size of the oven but also by the type. For example whether a continuous kiln or a stationary type annealing oven is used affects the length of cycle. If using a hand-fired coal oven, more time is required to reach annealing temperature than when using pulverized coal or oil. The matter of using packing or not also affects the time. For cupola fittings packing is not necessary. However, the stacks holding the fittings must be sealed tightly during the anneal. Time can be saved by leaving out packing as less time is consumed when there is no packing to heat through and to cool.

A successful cycle for a 55 to 60-ton oil-fired annealer has been to bring a bottom couple up to 1750 degrees Fahr. in about 16 hours, holding for 24 more and then cooling to 1100 degrees Fahr. in about 60 hours when the door may be removed. Another cycle that gave good results was to heat to 1600 degrees Fahr. in 16 hours, holding for another 30 hours and then cooling about as before. The thing to do is to explore and know your oven and then operate accordingly, making improvements in the oven if defects are found.

Test Bars Check Product

An excellent control method in addition to the use of pyrometers is to cast from one ladle of iron a large number of short flat bars which can be bent and broken easily. Place one or two of these in the bottom of each stack in the annealer and break them after annealing. This is a practical test which insures that no *under annealed* material will leave the annealing room.

Of course along with all these metallurgical and sand control methods the well-run shop will turn out a product of good appearance with fins and gates removed, and sand blasted or tumbled for fine finish.

Not only is appearance and control of quality important, but in addition the fittings must not leak. Frequent tests should be made on the various styles and sizes of fittings to assure that they are tight. The lower the casting temperature the less likelihood of leaks. However, making leak tests and establishing the best methods of gating and feeding is the means of producing sound fittings. A product of good quality can be produced when the follow-up of the various operations that enter into the making of cupola malleable are constant and unremitting.

Rectangular Pot Wanted To Resist Heat

Question: One of my customers wants a rectangular cast iron pot 5 feet in length, 2 feet in width, 16 inches deep with a 3-inch flange all around the top and with a uniform metal thickness of 1½ inches. This pot is to be used for heat treating steel parts and must withstand a temperature between 1400 and 1800 degrees Fahr. I have had no experience on this class of castings and will appreciate your advice on several points. For example: Should I place ribs in the casting and if so, what is the proper size and position for them. Is crude oil preferable to coke for heating the pot in service. Is a baffle plate advisable in the firing chamber. Is 1½ inches a suitable thickness for a casting of this kind. What is the best analysis for this casting.

Answer: Cast iron is not a suitable material for a pot subjected to a temperature of 1800 degrees Fahr. You either will have to use steel or a special heat resisting alloy. However, if 1800 is the maximum temperature to be touched only occasionally and if the usual temperature does not exceed 1400 or 1500 degrees, a good cast iron pot will last a reasonable length of time. As a preliminary measure we suggest you persuade the customer to change the design of the pot so that the bottom will be curved instead of flat. This will remove the dangerous conners where cracks usually start. Taking your questions in the order they are presented, the casting probably will last as long without as with ribs. The relative cost of coke or oil usually is the factor which decides which fuel is adopted. Either one will supply satisfactory heat. Whether or not you install a baffle plate in the firing chamber depends on the type of burner. The thickness of metal, 1½ inches is about the average. A suitable analysis for this casting is: Silicon under 1.00 per cent, sulphur 0.06 per cent, phosphorus 0.20 per cent, manganese 0.60 per cent and with total carbon rather lower than usual. Without a knowledge of what iron you have in the yard we cannot suggest a mixture, but since steel scrap, malleable pig and car wheel scrap probably are available, you will experience no trouble in approximating the foregoing analysis.

Describes Equipment

R. G. Haskins Co. Chicago, has published a 32-page catalog describing its flexible shaft equipments, tools and accessories. Numerous illustrations are used to show the various types of equipment and their application in industry. Specifications of the various machines also are given.

AN ENGINEER VISUALIZES FOUNDRIES of the FUTURE

By E. A. Custer, Jr.

IN THE first part of this paper which appeared in THE FOUNDRY for Oct. 15, the visitor of the future was taken on an imaginary tour of a plant where castings are made in a manner radically different to the methods which prevailed up to the present year of grace 1927. Melting apparatus and control mechanism based upon a modern ingenious theory were described. The guide continues to point out and describe methods and equipment connected with handling the sand, the molds and the cores, also the theory and practice of pouring the iron and cleaning the castings.

"Now for the way we prepare our sand and make our molds. Our foundry is divided into two nearly equal parts, the sand foundry and the metal mold foundry. The sand foundry division is here to the right of the pouring room.

"Sand from natural sources did not run as uniform and regular as we require so we developed the manufacture of synthetic sand. Of course, this was not new since synthetic sand was attracting attention as far back as 1917 and was pretty generally known by 1927. Just as we found one exact grade of metal, so we found that with this metal one exact grade of sand had to be used. We start with this moderate sized hopper, moderate because our sand reclamation to be explained later, is so complete that we do not have to carry a large reserve.

"This hopper contains carefully graded white or silica sand. Good sand can be obtained from any of the dunes along the Atlantic Coast although the sand that shows the least breakage of the minute pebbles or grains comes from Cape Cod and the vicinity of Long Island beaches.

"From the bottom of a hopper, a feeder spreads the sand upon a conveyor that carries it through a drier heated by waste heat from the furnaces. Sand automatically is measured into this synthetic mixer developed back in 1927. Here it is blended thoroughly, you might even say impregnated, with the exact proportion of bond that comes in on a small conveyor from the other side. The bond itself is compounded carefully in a smaller synthetic mixer.

"As the sand comes from the mixer it passes into a humidifier that adds and blends the exact proportion of moisture. Next, the sand is blown through what we call a *throw back* where a reverse current of air removes the fine dust from the sand. In its final condition we have a sand absolute in its quality and exact in its condition.

"We have four molding units although only three are in service. They take care of present production. The fourth is for sudden peaks in demand or a reserve in case trouble develops in any of the others.

"Two conveyors serve each molding unit, one carrying the cope and one the drag. Cope and drag flasks are secured on the conveyors as though they were integral parts. Parting lines are in the vertical instead of the former familiar horizontal plane. The reason for this will be apparent as we proceed.

"Flask parts pass first through molding machines where two carefully aligned faces or what might be called dies come up on each side of the flask and seal it. One die acts as a bottom plate while the other is the pattern. Sand is blown into the flask under pneumatic pressure, correct for the grade of sand and size of casting assigned to each unit. The dies then release the flask and draw the pattern, and as the conveyor moves on to the next step the pattern die revolves through the complete turn.

"In this revolution the pattern dies are subjected first to a heavy blast of dry air that effectively removes any fine particles of sand or dust that may adhere, then to a myriad of fine sprays so placed that every surface of the pattern matrix is sprayed with a thin, even coating of dry parting material.

"Every movement must be accurate. Alignment of patterns and flask must be perfect for we cannot permit the slightest trace of a fin or shift. First with metal, then with sand and then with molding operations we have studied and eliminated every possible cause for a defect in the castings.

"Conveyors carry the flasks through an enclosed chamber where the faces of the molds are sprayed evenly with a wet mixture that is both a facing and a binder. Then they pass through a drying oven where the facing is dried and at the same time where the molds are heated somewhat, a necessary feature in producing best results with the metal we use. This oven also makes use of the waste heat from the melting furnaces.

"Mechanism and construction up to this point have been comparatively simple and rugged, but in this next room or cabinet we have our only delicate mechanism. As the conveyors leave the ovens they start to converge at angles that will cause

them to meet before they leave the cabinet. In this cabinet, which in itself serves no other purpose than to protect the working parts from dust and dirt, a series of toggles and fingers lower the cores between the two halves of the mold to their correct positions, and then travel with the mold until the line of conversion has sealed the two halves of the mold. All core prints extend to the outside of the flask and the flask parting line is relieved to permit this. Thus, all cores can be suspended by the fingers and toggles from outside the flask and without interferring with the flask movement.

Pouring Bench

"When the flask has been sealed on the cores, the fingers release, the toggles withdraw, and the whole mechanism returns to the core conveyor where another core is picked up for the succeeding flask. This entire mechanism is governed by a set of cams on a revolving drum that is actuated by the movement of the flask conveyor, and is similar in many respects to the cam arrangement on many automatic screw machines.

"At the pouring bench as yet we have not been able to do away with the services of an operator. The metal moves above the conveyor in bottom pour ladles and as each flask comes to rest between steps the operator fills the mold. Top gates with scanty cups are just sufficient to guide the stream of metal. Even on heavy section castings risers or overflows, are not necessary with the metal we use. That means a considerable saving in gate and sprue costs.

"Conveyors then pass through to the next building containing all recovery apparatus. As the conveyors enter they start to diverge and as they open they pass projecting fingers that remove the casting and scrape all the sand affected by the action of the metal or the skin drying of the ovens, free from the mold. Castings and damaged sand drop on a slow moving conveyor on which the castings cool as they go to the cleaner.

"Flasks with undamaged sand move into a chamber where rotating air blasts effectively remove the sand. The flasks then return to the molding units in their continuous circuit. The sand, dropping into the hopper under the chamber is fed upon a conveyor that first takes it through drying ovens where it is freed from moisture. Then it is taken back to the discharge end of the big synthetic mixers where it is blended with the new made sand, humidified, passed through the throw back and thence to the molding units.

"Castings and damaged sand as they cool, move slowly to the cleaner. Structure of this new metal, due to its remarkable uniformity of expansion and contraction, is not damaged by sudden changes in temperature within wide limits. Therefore the quality is not endangered by shaking out the castings and exposing them to the atmosphere almost as soon as they are set nor by completing the cooling rapidly in the cleaner after they have reached the black heat.

"A hydraulic, abrasive tumbler patented and developed in 1927 in the middle west certainly does a most efficient job. Castings, sand and all, are fed into the open receiving end of a big revolving cylinder from the conveyor. As the load enters it is mixed with a flow of hard stars or jacks and the revolution and inclination of the cleaner carry all toward the discharge end. As they pass along they are met with innumerable streams of water. Some under high pressures tear into cores, pockets and angles. Others under a lower pressure, carry the sand and bite, polish and burnish. So many of them work at so many angles that every particle of surface is reached. With the grinding and rubbing of the stars, polishing and washing of the sand and water, the castings come out of the discharge end so bright and clean and smooth that they could be plated at once if desired.

"This same furious cleaning not only frees the sand of all of its bond but all adhering carbon is removed and the sand emerges in its original native form.

Sediment Basins

"Sand, stars and water pass through perforations in the lower end of the cleaner upon a separating screen that removes the stars. They are picked up by a tubular conveyor and carried in a continuous stream, back to the receiving end of the cleaner where they mix with the castings as they enter. The sand and water drop into sediment basins where the sand falls to the bottom, the bond and carbon are floated off, and finally the cleansed water is returned to the pumps to be used over and over.

"One eductor in the bottom of the sediment basin takes up a portion of the sand and delivers it to the pressure nozzles in the cleaner where mixed with water it is used instead of the dry sand blast. A second eductor picks up the remainder of the sand and deposits it upon a conveyor that carries it through the drying ovens and thence to the raw sand storage hopper where it again is used in the production of synthetic sand. This big cleaner not only gives perfect castings but reclaims over 90 per cent of the used sand and thus enables us to operate with such a small reserve.

"Castings as they come from the cleaner, are deposited upon a conveyor that carries them through the last section of the drying ovens where they are freed of any adhering moisture that might cause rusting or discoloration.

Metal Mold Shop

"All cores are made in much the same way as the molds are made. The same white sand, the same type of synthetic mixers, the same throwbacks and the same pneumatic molding machines are employed. The same type of conveyors carry the combination core boxes and drying frames from the molding machines to the ovens where they are picked up by the automatic charger and loaded on racks for passage through the ovens.

"The metal mold shop no doubt, looks more familiar for little change has been made in the molds themselves from the designs that prevailed when they were first patented back in 1908-10. You see the same revolving turn-tables, the same heavy metal molds and the same vertical parting lines but you also see far greater care and accuracy. Note the timing precision and how every factor is under the eye of the operator. The mold temperature is indicated on the dials on each mold. The metal temperature always is known, and from these two factors the operating time is set accordingly.

"For every shape casting, every grade of metal and every temperature of both mold and metal there is a definite operating time. There is a precise point where the initial expansion has ceased, where surface setting has been accomplished and where it is desirable to arrest the segregation of the carbon. We know our metal grade, all our temperatures and we determine the shape factor by trial. With all factors known we can operate with certainty.

"We do not use any mold facings or coatings for protection nor do we use any oil or water cooling devices. The molds in size and shape are rigid enough to maintain alignment and have body enough to absorb and

radiate the heat as fast as it is applied. The surfaces of the mold coming in contact with the molten metal, or the matrix as we call it, is prepared carefully during the first few pourings by what we call burning or *killing* the faces. We render them dead or inert and in a condition where the metal to a great extent, has lost its power to expand and contract and cannot be *burnt* by contact with molten metal. In this state the life of the mold is nearly as long as when the best protective coatings are used. Maintenance of any given mold temperature is not nearly as important as correlating the mold temperatures with the other factors.

Temperature Limits

"See how it clocks around. Here is a battery of motor fly wheels, here cylinder heads, over there valve bodies and all sorts of castings. The same arrangement of fingers and toggles receive and place the cores.

"Accuracy is the keynote. The metal always is kept the same in grade and within close limits of temperature. Each class of castings has its established time. The operator merely glances at his chart and observes what the operating time should be for each set of conditions. On a keyboard he simply presses the key corresponding to the time he wants. When he moves the lever to cut the stream on one mold, the table moves to the next position. When the exact time has expired the mold automatically opens and extruding pins drop the red hot castings upon the conveyor that takes them out.

"Castings are inspected in the final receiving room, over in that next building, and the few that need gates removed or ground are taken care of. These are few for all gates are designed to break flush with the casting and nearly always do so. If a casting comes through with a fin or shift it is rejected and the cause for this defect at once investigated and corrected.

"We are pouring 50 tons per hour with less than 20 men and most of these are engineer observers who comb over the whole system and watch for the slightest deviation in accuracy. All mechanical equipment is designed to be light but at the same time practically wearproof. All structural or conveyor members are made of a light, high tensile alloy that appeared in 1925, possessing great strength with minimum weight. All bearings are not only dust proof but oil-less and are made, as are all the wearing parts of that frictionless, or nearly so, metal that made its appearance in 1926. With this lightness and freedom of motion, power cost really is remarkably low.

"These perfectly formed castings, absolutely true and sound, are far superior in every qualification to cast iron, and in some respects to malleable iron, and the cost per ton of finished castings is less than 30 per cent of what it was in 1927."

We wake up with a start, pull our heels down from the desk corner, straighten up in our swivels and start to think. The engineer in his way, the foundryman, the scientist and the metallurgist in his. What jumps first to his mind? What is the first reaction? Perhaps some one gives voice to it, to which, the retort courteous,—Wake up! You're on your back.

Propose Specification for Foundry Iron

The federal specifications board is promulgating and adopting purchase specifications for commercial commodities purchased by the various departments and establishments of the United States government, and recently has proposed a specification for foundry pig iron. The specifications board which is located at Washington will be glad to receive any comments or suggestions for changes in the specifications which follow:

I. GENERAL SPECIFICATIONS

There are no general specifications applicable to this specification.

II. GRADES

Foundry pig iron shall be furnished in grades 1 to 4 inclusive, unless otherwise stated in the contract of purchase order.

III MATERIAL

The material shall be in accordance with the requirements contained in the following paragraphs.

IV. GENERAL REQUIREMENTS

1. The pigs shall be free from excessive sand or slag.

2. Not more than 12 per cent of sow iron shall be accepted; any shipment of any grade and such sow iron shall be of a size easily handled.

V. DETAIL REQUIREMENTS

1. Pig iron of the regular grades shall conform to the requirements as to chemical composition specified in the accompanying table.

2. Pig iron of special grades shall conform to the requirements as to chemical composition specified in the contract or order and in such cases the following variations shall be allowed.

Silicon	Plus or minus 0.25 per cent
Manganese	Plus or minus 0.20 per cent
Phosphorus	Plus or minus 0.10 per cent
Sulphur	maximum as specified
Total carbon	Plus or minus 0.25 per cent or minimum as specified

VI. METHOD OF INSPECTION AND TESTS

1. One pig shall be taken for every 4 tons in the lot, chosen from different locations so as to represent as nearly as possible the average quality of the lot. A lot shall always consist of pigs from the same casts, no mixing of iron from several casts being permissible.

2. The pigs selected for test shall be broken so as to present a clean fracture over the cross section of the pig. One half of each pig shall have drillings taken from three points triangularly spaced on the clean part of the fracture. An equal proportion of drillings from each pig of a lot shall be thoroughly mixed and analysis made from this sample. No resampling will be permitted.

3. The inspector shall obtain not less than 6 ounces of the sample, taken and mixed as above, for analysis. In case the first analysis shows that the material does not conform to the specifications, a check analysis shall be made. The average of these analyses shall be considered final.

Note: Suitable methods for umpire chemical analysis are being developed and will be included as an appendix at a later revision.

VII. PACKING AND MARKING OF SHIPMENTS

VIII. NOTES

1. Bidders shall state whether the iron they propose to furnish is machine cast or sand cast.

2. Other things being equal, preference will be given to machine cast pig iron.

3. Contracts or orders should state the minimum total carbon desired.

Specifies Chemical Composition

Grade	Silicon, per cent	Sulphur maximum, per cent	Manganese, per cent	Phosphorus per cent
No. 1	2.75-3.25	0.04	0.50-1.00	0.50-0.80
No. 2	2.25-2.75	0.05	0.50-1.00	0.50-0.80
No. 3	1.75-2.25	0.05	0.50-1.00	0.50-0.80
No. 4	1.25-1.75	0.05	0.50-1.00	0.50-0.90

Observations on Casting
Aluminum and Its Alloys

By W. J. Clark

GROWING demand for lighter parts in many mechanical units has brought aluminum and its alloys into increasing prominence and forced the foundry to a deeper study of this metal and its casting peculiarities. A molder's observations of a few of these peculiarities may be of general interest to nonferrous founders who cast this metal.

The subject naturally divides into two phases, first the melting and alloying of the metal and second, its molding. Pure aluminum is a rather soft, tough, ductile, malleable metal. It is to the lighter alloys what copper is to brass and bronze; a good substantial base. It is unfitted for some mechanical needs, yet is capable of modification for the physical demands on the casting. These modifications are primarily a hardening or a stiffening of the metal by alloying it with some other element.

Of these modifying elements copper and zinc are most prominent, giving rise to the aluminum-copper alloy and to the aluminum-zinc alloy. The general departure from the all-aluminum properties in both alloys is an inclination toward hardness, brittleness and rigidity. Further modifying metals sometimes used are iron, tin, magnesium, nickel and silicon; all in small percentages. Silicon up to 3 per cent tends to lower shrinkage effects in pure aluminum and renders similar results in many of the aluminum alloys.

Uses Standard Alloy

Of all aluminum alloys I like the standard aluminum-copper alloy, aluminum 92 per cent-copper 8 per cent, best to mold. This alloy casts consistently, runs clean when properly manipulated and shows a clean uniform grain. Of the aluminum-zinc alloys this cannot always be said. I have found it a more drossy metal with shrinkage higher and uniformity not so prominent. In heavier work the zinc sometimes settles to the bottom or lowest parts of the casting. For this reason I treat the aluminum-zinc alloy as I do the high lead-copper alloys—stir it well before pouring.

Melting of the aluminum for castings has been done in under-fired iron pots, and in crucibles. Between the two I like the metal coming from the iron pot better. It seems cleaner, less scummy and drossy and more uniform.

Fluxing of the metal is done with chloride of zinc. This when kept under cover is a dry powder but when exposed to the atmosphere becomes damp and pasty. A little of the chloride (about a tablespoonful) is thrown on the surface of the metal and the scummy, drossy characteristic disappears leaving the metal clear and limpid. I recently witnessed a bad accident where a man almost lost an eye from the use of this damp pasty chloride. In attempting to stir the metal the man got a quantity of the wet chloride under the skimmer submerging it into the metal. The result was the usual explosion which in this case threw metal into the man's face burning it severely.

In aluminum and all its alloys I pour the metal just as cold, as clean, full and sound running as the casting will permit. This pouring temperature I have always determined by judgment. An average temperature as indicated by color and by general appearance resembles quicksilver although the nature of the casting often compels a variation from this average temperature. At higher temperatures the metal proceeds to red, to yellow. High pouring temperatures always carry penalties of drossy and porous metal, of high shrinkage, and of the disturbance of the casting metal in the mold caused by the metal lying liquid in the mold until after its heat has caused the mold to seam up unduly.

The outstanding peculiarities of aluminum as compared to the heavier metals and alloys in molding I have found to be chiefly the following:

It has a higher shrinkage.

It has a tendency to draw, crack and break in cooling.

By agitation it will work up froth and dross from the metal more pronouncedly.

Being a lighter metal it is much more susceptible to the effects of dampness, hardness, etc., in the mold.

Its melting and its proper pouring temperature are in general more critical factors of results.

The molder has to mold to counteract these things. First of all he must reckon carefully with his sand. The metal is comparatively easy on sand. Its lightness, its low static pressure and its temperature all tend to make it so. Sand can and should be tempered therefore to a marked state of dryness. My invariable practice is to use sand as dry as I can work it and with as little new sand added to the heap as possible. This insures exemption from excess of generated mold gases. Likewise, the tamping of the sand never should be any harder than absolutely necessary. In swabbing the pattern for drawing, a minimum of water should be used and if there is any place that water should be kept away from the inside of a mold, it is in aluminum.

Cores Made of Open Sand

Dry cores should be made of an open sand, well vented, soft, thoroughly dry and with a minimum of bond. Liquid aluminum will displace under slightest gaseous pressure and core gases under no consideration should get to the metal. To guard against dampness in cores,

Presents Views

CERTAIN precautions must be observed in melting and casting any metal or alloy. However, in melting and casting aluminum and its alloys greater caution is necessary due to the lightness of these metals and the ease with which they oxidize in the molten condition. This article and a companion one that will appear in the near future present some views of a practical molder on his experience with aluminum and its alloys.

green sand aluminum molds should be poured immediately after closing. During contraction in cooling around a core, aluminum stands little resistance before cracking. For this reason cores should be soft and collapsible. Core bonding agents have much to do with this and we have the oil bond, the rosin bond, and the vegetable bond as flour, etc. The oil bonded core softens with heat and then re-hardens shortly afterward. The rosin core softens more perceptibly but will also afterward harden as the casting cools. It is a safer core and quite efficient if closely watched. Two important features attend its success. They are that the rosin should be finely pulverized and thoroughly and uniformly mixed with the sand in making the core, and that the core should not be baked too hard in the drying.

A rosin core too thoroughly baked in its drying will not soften and yield as it should under the heat of the metal that surrounds it. The same is more or less true of the oil bonded core. The vegetable bonded core is practically constant under heat and if made decidedly soft is a fairly safe venture. Wherever possible all cores resisting shrinkage in the mold should be made on the order of a shell core, that is, hollowed out. To further guard against cracking, practice is common to shake aluminum castings out hot and carefully loosen the core to decrease its resistance.

Employs Green Sand Core

In general, I long have been partial to the green sand core rather than the dry core wherever the substitution can be made. To this end I have many times discarded the dry core and made my own green core supported by an arbor, a carrying tray or some other devised means. Fig. 1 will illustrate a thin walled box with inside walls to be made with a dry core. I discarded the dry core, rammed a green core up using a metal bottom plate a screw hole and inset in the core box while ramming up the core. Into this plate I screwed an eye bolt, carried the core to the mold and set it, removed the eye bolt and filled up the hole with sand. That gave me a green core and a more safe and satisfactory outlook.

Because of the lightness of the metal and its lower liquid temperature aluminum can be molded in

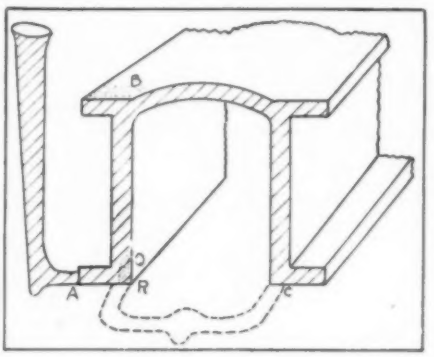


FIG. 3—FLANGED FRAME CASTING SHOWING ORIGINAL AND IMPROVED METHODS OF GATING

green sand to a greater limit regarding size and weight of casting than brass, bronze, iron and the heavier, hotter metals. At that point, however, where the dry mold is required I have found the same principles of softness, of dryness, of minimum of gases, of venting, etc. equally imperative as in the green sand mold. All in all the condition of the sand, its ramming, venting, etc. for any aluminum casting is an important factor in results. A further item regarding sand is that it should always be cold, never hot and steaming.

Probably no phase of aluminum molding is more critical than the gating of the mold with respect both to running the mold and to feeding the casting against shrinkage. The first great objective is to so gate as to deliver the metal to the mold with a minimum of agitation since this agitation always tends to a drossiness more or less pronounced in the casting. To this end I always gate aluminum with a view of avoiding turbulence of flow or height of drop or mixing of hard currents of metal either in the gates or in the mold proper.

Check Wild Metal

Flat molds of large surface I generally incline against the metal flow thus checking its wildness in the mold. Another method is to check the metal in the runner gate before it gets to the mold. This is obtained by using a thin gate section between the pouring sprue and the point of delivery to the casting. Flat castings frequently are poured *double up* from opposite sides of the mold. In such cases the opposite gates should be kept out of line with each other allowing the entering streams to pass instead of meeting each other and creating agitation.

In deep molds I gate as close to the bottom as I can and in such a way as to allow the metal to rise in the mold placidly. Not all bottom gates attain this objective and those that do must be developed to obtain this particular capacity. A study of different methods of realizing this end appears in Fig. 2. First, the drop gate should never exceed a 2-foot unbroken descent. If the depth to the bottom is greater than two feet then the drop sprue *P* should be broken as in *B* to escape the hard smash of height of fall. As a further restraining influence over metal current a check should be placed on the metal in the gates themselves.

In *C* of Fig. 2 the advantage of relative position of this check ap-

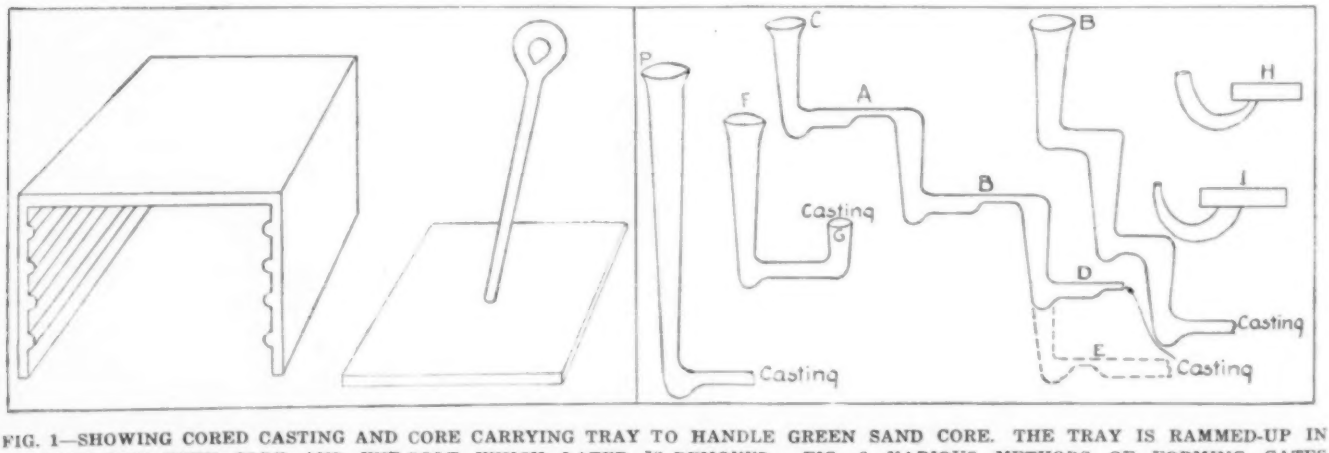


FIG. 1—SHOWING CORED CASTING AND CORE CARRYING TRAY TO HANDLE GREEN SAND CORE. THE TRAY IS RAMMED-UP IN CORE BOX WITH CORE AND EYE-BOLT WHICH LATER IS REMOVED. FIG. 2—VARIOUS METHODS OF FORMING GATES FOR ADMITTING ALUMINUM TO THE MOLD

pears. A principle of good pouring is to keep the gates full. Many advantages might be pointed out in support of this principle. Now if we check at point *A* no part of the gate is kept full in running except the pouring sprue up to the point of check and the rate of motion within the gates becomes slow, lazy and listless. If we check at point *B* the disadvantage decreases in proportion to the distance from point of check to the point of delivery but does not entirely disappear.

If we check by a thin gate right at the delivery point as at *D* then the full and free pressure of the sprue forces the metal violently through the thin gate *D* into the mold with a nozzle like effect. For these reasons I have found it best to do the checking in the last runner gate and not too close to the casting as at *E*. Another possibility of checking the wildness of current into the mold is shown in *F* of Fig. 2. It consists in bringing the metal up from a distance from under the mold through an enlarging gate as at *G* in *F*.

Frequently molds for aluminum are gated with a horn gate. In its natural position this gate resembles a nozzle and delivers a strong current. By reversing its natural position as in *I* as distinguished from *H* in Fig. 2 the situation is improved. Impediments to a stream of metal entering the mold are further factors of agitation. As a general rule a metal current should be allowed to spend its force and die away naturally. If a metal current be directed against a mold core or a mold wall or other such obstacle in the mold a decided disturbance is set up not conducive to best results. In aluminum it is always better to gate clear of such obstructions.

In gating to run the mold a further factor of agitation appears in the steaming up of the sand in localized spots. These spots or sections materialize where too much metal is delivered over a given mold surface and often follow feeding the casting through a single running gate. Many times I have seen the casting show spongy and drossy around this single gate section. It is always better to deliver metal through a number of runner gates so distributed as to subject no one mold section to excessive metal action. A large casing cap gated by a single gate on the flange had to be scrapped on account of spongy metal around the gate. Four multiple gates were made and showed satisfactory results.

Often in the larger castings I find a great advantage in allowing the surface of the mold to air dry and frequently go so far as to use a blow torch cautiously to skin dry the mold. If the sand has fair natural bond no spraying of the mold is necessary before drying such molds since, as before stated aluminum is decidedly easy on sand. Some of the cleanest and smoothest castings I ever molded were made in this way. In the skin dried mold and in the all-dried mold involving artificial bond, this bond should always represent a weakened condition for aluminum as compared to other metals.

Ordinarily a facing such as talc, plumbago, etc. is not requisite to aluminum and I seldom if ever resort to it. Dusting flour on the mold as often is practiced in brass and bronze is prohibited in aluminum.

In all aluminum work of importance the machined surfaces of the casting should be known and these surfaces cast in the drag of the mold wherever possible. The pattern should be constructed to this end and when not so constructed should be altered to this objective. Either that or foundry equipment changed to suit the purpose. In aluminum it is no easy matter to get a clean solid casting surface from the cope side of a mold. I have seen many failures and many times have expended much time and labor to get the finished surface of a casting at the bottom rather than the top of the mold.

Bottom gating and bottom surface position, is not always a guarantee against drossiness. This point is illustrated in a large flanged frame gated at the bottom with a single gate as at *A*, Fig. 3. The gate delivered the metal hard against the dry shell core forming the inside of the casting. The result was the inevitable hot spot and drossiness at *A* and a sponginess at *B* on the upper flange directly above the gate entrance. The remedy was to double gate at *R* and *C* at the bottom delivering the metal into the open mold along the lines of the core. This prevented the hot spot and the agitation of impact thereby resulting in a vastly improved casting.

Contraction of aluminum is decidedly high and its resistance to strain low. In engaging these tendencies we have primarily three weapons to oppose them, first the pouring temperature, second the chilling of casting parts and third the feeding of the casting. By and large I have found the proper pouring temperature of aluminum to be the lowest point at which it will consistently run the mold. These lower pouring temperatures result in cleaner better metal and happily are exempt from those higher shrinkages attending the hotter pour. They have the further advantage of permitting the metal to freeze in the mold before the sand of the mold has generated its damaging gaseous pressures.

Philadelphia Foundrymen Hear Many Items

At the first fall meeting of the Philadelphia Foundrymen's association held in the rooms of the Manufacturers club, northeast corner Broad and Walnut streets, Wednesday evening, Oct. 12, Howard Evans, secretary, announced that as a result of the marvellous success of an outing which closed the summer season, plans already were under way for a similar event next summer. In the meantime an interesting program has been laid out for the winter meetings under the direction of L. U. Park, Park & Williams Inc., chairman of the papers committee.

Pat Dwyer, engineering editor THE FOUNDRY, speaker of the evening had for his text outstanding examples of skill and ingenuity on the part of foundrymen, past and present , in many lands and under widely varying conditions. He stated that the phenomenal growth of the automobile industry in recent years, gradually is revolutionizing the foundry. Methods, processes and mechanical equipment designed and placed in operation to cope with an extraordinary demand for one class of castings, gradually are seeping into other sections of the foundry field where they are trimmed and adapted to meet special conditions. In the general discussion which followed, many interesting opinions were expressed on present trade trends, invasion of the gray iron fields by steel and malleable iron, prospects for developing new fields, efficacy of advertising and publicity and the feasability or practicability of erecting a blast furnace in the vicinity to supply the Philadelphia district with pig iron.

Walter Wood, president R. A. Wood & Co. and president of the Philadelphia Foundrymen's association suggested that preliminary steps be taken toward the formation of a research association in connection with the American Foundrymen's association, patterned in a general way after the British Cast Iron Research association which maintains a regular staff constantly engaged on research.

How and Why in Brass Founding

By Charles Vickers

Holes Cause Trouble

We are casting bronze sleeves four feet long and with a 6-inch diameter core through them, and experience much trouble getting them perfect. We first tried green sand, gating on top with a series of sprues, the metal used being eighty-five, three-fives bought to analysis. These castings showed holes all over after machining. There were no indications of dirt, and we do not blame the metal as with smaller sleeves we have good success. We then tried all virgin metal with a little phosphor-copper as a deoxidizer, using dry sand molds and pop-gating the same, the sand being gravel. When these were machined they showed spots all over the casting, as though the grain of the metal was open; a spongy, porous appearance. Next we tried many different things; we left the compound out of the cores in some instances; then made a couple minus risers, and one we gated from the bottom. We would appreciate it if you will please answer the following questions: (1) Do you approve of a compound in a core? (2) Do you approve of a riser, or not? (3) Is it proper to use all virgin metal, or should a little scrap be mixed in with it? (4) What method of gating do you advocate on castings like this? (5) We are melting in pit furnaces, using coke; is this correct? (6) Do you approve of the use of a thermometer for determining the temperature of the metal, and if so, could you recommend one to us?

To question (1): Certainly, as the prepared core compounds and core oils such as are advertised in THE FOUNDRY are far superior to the old-fashioned methods of bonding cores. (2) Risers are a necessary evil; the metal when molten is in an expanded state and the natural shrinkage upon solidification has to be compensated for and a riser or feeder is required for this purpose. (3) Quite proper, but sometimes more expensive. It is not necessary to add scrap or secondary metals to a virgin melt. It is a matter of economy. (4) We have no particular preferences as to the method of gating. Some get good results from top gating; others get the same results when bottom gating. Probably if a vote could be taken, the majority would favor bottom gating. (5) It is quite correct to melt in coke-fired crucible furnaces, although they are slow melters. (6) Yes; we approve of the use of all scientific instruments. A pyrometer has to be kept accurate, and will give best results in the hands of technical men. Refer to the advertising pages of THE FOUNDRY for these instruments.

We presume that in melting the metal in these coke-fired furnaces that charcoal is used for covering the metal, and that it is heated to a temperature in the furnace much hotter than needed for the mold. This confers liquidity and permits absorbed gases to arise and escape, and also allows sufficient time to bring it to the mold side at the proper pouring temperature. As a bush cast upright, or on end is entirely enclosed by wood or iron in the shape of the flask, we would ask, "How are the gases going to get away?" We suggest a study of the articles on Chinese molding practice in the Feb. 15, March 1 and March 15, 1926 issues of THE FOUNDRY.

Gives Bright Acid Dip

We note in April 15, 1926 issue of THE FOUNDRY *an article on dips for pickling brass castings. We have tried dips similar to the ones given and found them satisfactory for removing the sand. We do not have a sand blast in our foundry as we use a rattler, but the latter is not successful in getting the color on the castings. We would, therefore, like to learn if it is necessary to use the sand blast before dipping to get the color, and if so whether the acids mentioned are the ones to be used after the sand blast?*

If the sand blast is used before dipping the castings a pleasing bright color will be obtained. Acids used for removing the sand are not suitable for bright dipping. A bright dip usually consists of equal parts of nitric and sulphuric acids with about a dessert spoonful of common salt added to each gallon of the mixed acids. A weaker dip consists of 2 parts sulphuric acid to 1 part nitric acid. Sometimes the nitric acid is in excess as in the following dip; 2 gallons nitric acid; 1 gallon sulphuric acid; ½ gallon water. The latter must be added with great care gradually to the nitric acid first, the sulphuric acid being added in small installments with stirring between. Use a glass rod to stir. It will be noted the two acids mostly used are nitric and sulphuric and that the proportions can be varied greatly. After such dipping the castings must be washed well in running water. After neutralization they should be dried rapidly to avoid staining.

Uses Zinc-Tin Alloy

We would like to obtain a non-shrinkable metal for pattern work and have under consideration two formulas for white metal as follows: No. 1 Zinc, 50 per cent; tin, 50 per cent; No. 2, tin, 16 pounds; lead, 3 pounds; zinc, 6 ounces; antimony, 10 ounces. We desire to learn which of the two formulas is the cheapest and the most practical to use. Also give us your reason for your decision.

The No. 1 formula is the cheaper as it contains only 50 per cent tin against 80 per cent for No. 2, and seeing that tin is by far the most expensive metal in the two alloys, the one containing the least cannot be other than cheaper.

The No. 2, formula reduced to percentages is as follows: tin, 80 per cent; lead, 15 per cent; zinc, 1.875 per cent, and antimony, 3.125 per cent. Due to the fact that in alloys of the character of No. 2, zinc is a great detriment because it causes heavy drossing and loss of metal, also interferes with the fluidity of the alloy so it flows into sand molds with difficulty it will be evident that the formula is a poor one to select and that there is no comparison between the two. No. 1 alloy also contains zinc, but this metal is composed solely of tin and zinc and owing to the large percentage of zinc contained therein, it will give good and consistent results. It is advisable though to add a piece of common sheet aluminum 2 inches square to each pot of the alloy, this piece being sufficient for 100 pounds of the alloy.

There is no such alloy as a non-shrinkable pattern alloy, therefore, it is useless to look for one. They all shrink, some more than others, but the 50-50 zinc-tin alloy is noted for low shrinkage.

Bakes Cores in Gas Furnace

By R. G. Van Grundy

QUALITIES desired in cores are easy to sum up and hard to secure. Some of the characteristics wanted are strength with low cost of binder, a smooth surface with free venting, resistance to wash and pressure of molten metals, together with the ability to crush and clean out readily. Cores should throw off but little gas in baking or in use, it is essential they should be strong enough to withstand any necessary handling while green, bake quickly and not absorb moisture when stored. Some of these demands are conflicting, and a satisfactory compromise is sometimes difficult to secure.

FIG. 1—CORE OVEN ON THE LEFT IS NOT INSULATED

To produce good cores the coremaker should understand why each material is used. Many items enter into the selection of materials. Some of them are: Character of metal, pouring temperature, size and section of metal in casting, and size and section of core.

A sand should be used which has a low percentage of free clay and which is free from lime, alkalis, silt and vegetable roots. The lime and alkalis flux the sand at high temperatures and may cause the core to buckle, and parts of the core may spall off and cause dirty castings. Vegetable matter burns at low temperatures and forms some gas, while the silt fills the voids and stops free venting of the sand. The use of coarse or fine sand depends on the class of work to be done. Fine castings call for sand whose grains should be small and even in size. The grains of sand should be of uniform size, whether the work to be done is fine or heavy.

The coremaker should understand the use of binders. Binders are used to hold together effectively the individual grains of sand, so that the core remains intact and rigid until a sufficient amount of the liquid metal in the mold has set, that is, until the metal will no longer flow or the casting loses its shape. The core must be of such structure that it will collapse and crumble at the proper time, allowing for contraction of the casting. To clean the casting the core must lose its binding qualities.

The gases produced from various core ingredients are the elements in producing castings that give the foundryman considerable trouble. Use of good binders will reduce the formation of this gas. Some of the qualities of good core binders are: Uniformity, nongumming, small gas production and rapid combustion.

Requires Care

GOOD cores are essential if satisfactory castings are to be produced. The various steps in the making and baking of cores must be studied closely if the foundryman is to avoid the many pitfalls created by defective cores. It is necessary that the best materials, such as sand and binders, be used, that the ingredients be properly mixed and that the methods of baking produce the desired results. Numerous factors, which should be given careful consideration by the foundrymen, are discussed in this article which is abstracted from an article appearing in Industrial Gas. The author is connected with the Pacific Gas & Electric Co., San Francisco.

The casting should be allowed to contract when cooling, it should not be hygroscopic, and should dry thoroughly to the center of the core. There are several oils used for binding cores. Undoubtedly linseed oil is one of the best due to its high binding power and flowing qualities among the sand grains. It is used mostly by the special core oil manufacturers as the base for their mixture. China wood oil is an ideal drying oil and has a good film value, or, it flows readily over each grain of sand. The soya bean oil, another Chinese oil, is used extensively with linseed oil.

Sand cores are made up of moist sand and a core binder. The moisture is added to give adhesion at room temperature and to bind the sand grains together until the core has been baked and the grains of sand cemented together by the binder. Baking is necessary to remove the water and oxidize or harden the core oil into a hard, permanent cement, binding the sand grains firmly so that the core will stand handling.

The core binder is present in the green sand core as globules or minute drops of oil, more or less uniformly distributed throughout this mixture. Since oil and water do not mix, and the water is already covering the sand grains, the minute drops of oil occupy the spaces between the moisture-coated grains of sand.

The ideal method of baking these cores would be to raise the temperature slowly enough (the time depending on the size of the core) so that none of the binder would be oxidized or hardened until all of the moisture had been evaporated.

As fast as the sand grains begin to lose their moisture, the oil in contact spreads out over the grains of sand, coating the grains with a film of oil, just as they were coated with a film of moisture, the transition from film moisture to film oil taking place gradually, beginning on the outside when heat and air circulation

are first to affect the core appreciably.

The phenomenon of capillary attraction at the point of contact of two sand grains takes with oil just as with water, except that the capillary attraction is greater with oil than with water, the oil being more viscous.

The displacement of film moisture with film oil disposes of the minute drops of oil between the grains of sand and opens a passageway for the moisture and steam to escape from the interior of the core.

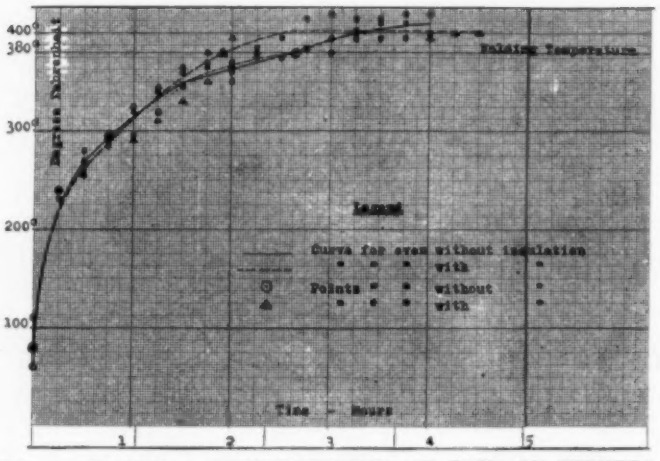


FIG. 3—GRAPHICAL REPRESENTATION OF RATE OF TEMPERATURE RISE FOR EACH OVEN

The heating of the core to a temperature sufficiently high to evaporate all the film moisture reduces the viscosity of the oil binder and permits it to flow evenly in a thin coating all over the grains of sand. This permits the use of a minimum quantity of oil and at the same time provides as large passageways as possible between the grains of sand for the passage of gas or moisture.

If the temperature is raised too rapidly, the oil will begin to harden or oxidize between the grains of sand before the film moisture has had a chance to evaporate and get away. The result will be a poorly vented core because the minute passageways between the sand grains would be choked up with the hardened drops of oil.

After the moisture has been evaporated, further heating drives off the light, volatile portion of the oil binder which escapes in the form of a gas. To harden the oil binder requires both heat and oxygen. Raising the temperature takes care of one requirement, but unless the core has been treated properly in the early stages, furnishing the proper amount of oxygen in the form of air in the interior of the core is a difficult problem. If the core has had a proper preliminary baking, the temperature having been raised slowly, air will have no trouble in finding its way into the interior of the core, thus uniformly oxidizing the oil and producing a strong uniform core.

Care must be used not to raise the temperature high enough to burn or carbonize the oil. If the core has been improperly handled, the outside of it will be found to have a hard skin. The interior of the core will be soft, and, if the temperature is forced high enough to bake it, the oil on the outside will be carbonized.

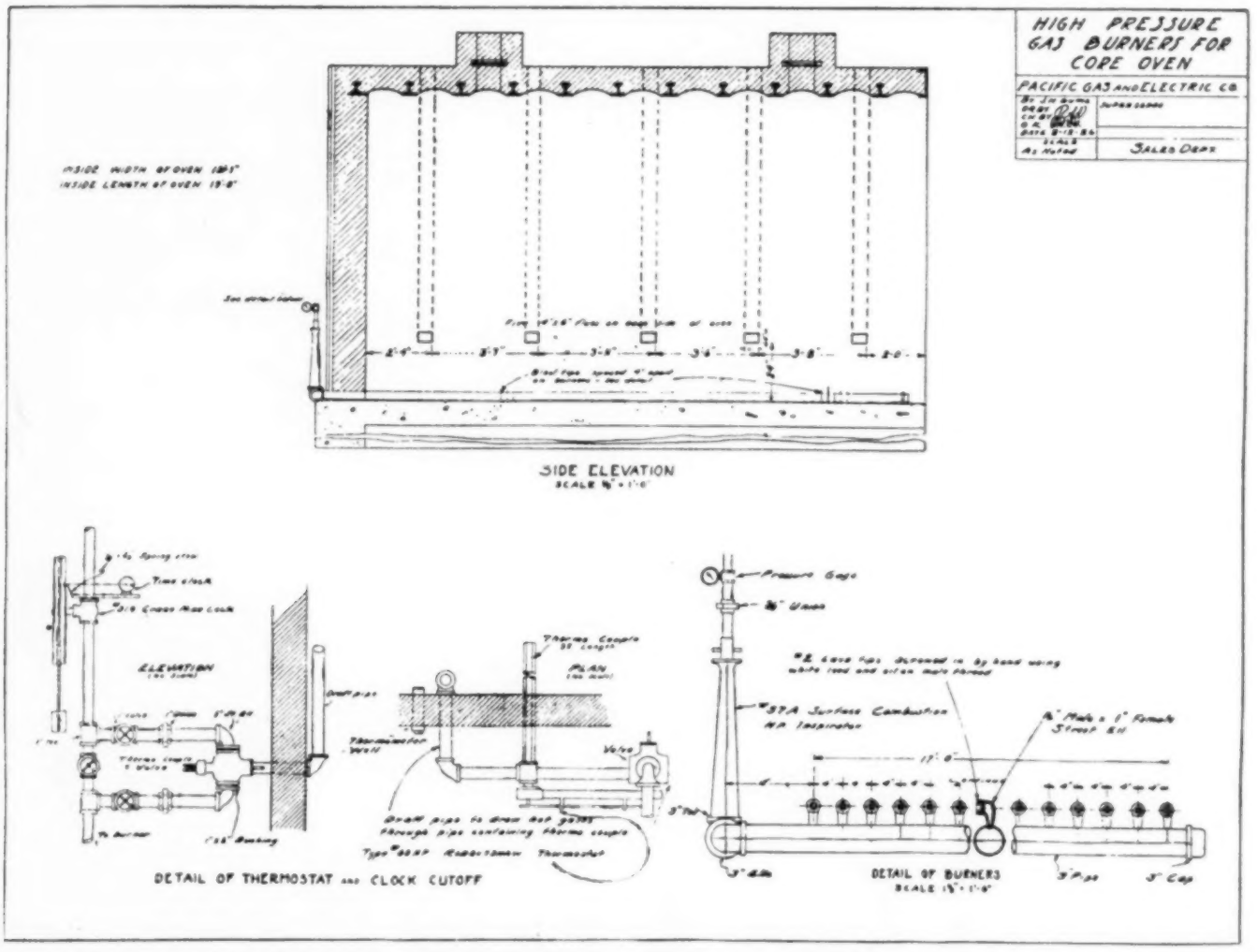


FIG. 2—SIDE ELEVATION OF GAS OVEN WITH BURNER, THERMOSTATIC CONTROL AND CLOCK CUT OFF

Table I

Operation of Core Oven Without Insulation

USING 550 B.T.U. HIGH-PRESSURE GAS, HIGH-PRESSURE GAS INSPIRATOR AND MANIFOLD BURNER

Date	Approximate weight of green cores: Oil sand Lb.	Compound Lb.	Total Lb.	Gas used, cubic feet at 6 in. pressure	Operating time: Hr.	Min.	Gas pressure at start, Lb.	Operating holding pressure, Lb.	Time to reach Holding Temp. (380° F.): Hr.	Min.	Remarks
4- 5-26	3,610	1,270	4,880	5,380	4	10	5	3	2	40	
4- 6-26	4,099	1,886	5,985	5,050	4	15	5	2½	2	45	
4- 7-26	4,500	142	4,642	4,870	4	....	5	3	2	45	
4- 8-26	1,650	55	1,705	4,740	4	....	5	3	2	30	Temp. of oven 8 a. m. next day 148° F. Small load
4- 9-26	2,400	43	2,443	4,500	4	....	5	2½	2	30	
4-14-26	3,640	20	3,660	4,900	4	....	5	3	2	40	
4-15-26	3,120	10	3,130	5,000	4	30	5	2½	2	30	
4-16-26	4,850	47	4,897	5,120	4	....	5	3	2	40	
Total	27,869	3,473	31,342	39,560							

Total weight of cores dried, 31,342 pounds. Total number of cubic feet of gas used, 39,560. 1.26 cubic feet of gas used per pound of green cores.

The binding or holding power of the oil is destroyed, permitting the sand grains to crumble and fall apart. Such cores are said to be burned.

The importance of proper baking cannot be overestimated. Gas as a fuel possesses numerous advantages, the two having immediate bearing being:

Combustion is easily controlled, the atmosphere can be kept oxidizing, reducing, or neutral as desired. An oxidizing atmosphere is required in baking cores.

Temperature control can be effected through the use of direct acting thermostats.

A California foundry is now equipped with two large gas-fired ovens which were installed in place of coke-fired ovens. The first oven was built without any insulation and the second one with a spiral brick insulation.

Fig. 1 is a picture of the two ovens; the one on the left is not insulated, while the right-hand oven is. The car in the right-hand oven is loaded with a core weighing approximately 34,300 pounds. The burning gas can be seen at the ports of each manifold burner in each oven.

The outside measurements of the ovens are 14 feet 2 inches, in width, 20 feet 7 inches in length, and 11 feet 6 inches in height. Each oven is equipped with a high-pressure gas inspirator which feeds into a horizontal manifold at the rear. Fig. 2 is a drawing showing a side view of the oven and gas burner with the thermostatic control and clock cut off. The inspirators and automatic controls are located at the rear and in the center of each oven. The manifold is made of 3-inch pipe and runs along the sides and back of each oven. The burner ports consist of ½-inch to 1-inch elbows and blast tips (see drawing). There are 50 ports spaced 4 inches apart from center to center on each side of each oven.

The ovens are controlled by two high-pressure thermostats and an electric range clock. The thermostat holds the temperature at 400 degrees Fahr. and the clock releases a weight which closes the main gas valve at any set time. Each oven is equipped with a signal light which shows when the oven is operating. In Fig. 2 is a drawing which shows the thermostatic control and clock cut-off arrangement.

Detailed operating data were taken on the core oven without insulation using gas containing 550 B.t.u. per cubic foot. These data were taken when the oven first was installed and operating under varying conditions to determine the best conditions for drying. The operating period which was eight hours on Dec. 12, 1924, was gradually reduced during the next 30 days, and the gas pressure at the start was increased to 5 pounds while the holding pressure was also increased from 1 to 3 pounds.

On Jan. 14, 1925, the uninsulated oven was loaded with approximately 10,000 pounds of oil sand cores and 9512 cubic feet of gas, containing 550 B.t.u. per cubic foot, were consumed to dry them. The oven was operated from 5.30 p. m. until 10.30 p. m., a period of five hours. When the oven was started, the gas pressure was 5 pounds per square inch. The pressure dropped gradually over a period of three hours to 3 pounds. At the end of this 3-hour period a temperature of 375 degrees Fahr. was reached

Table II

Operation of Core Oven With Brick Insulation

USING 550 B.T.U. HIGH-PRESSURE GAS, HIGH-PRESSURE GAS INSPIRATOR AND MANIFOLD BURNER

Date	Approximate weight of green cores: Oil sand Lb.	Compound Lb.	Total Lb.	Gas used, cubic feet at 6 in. pressure	Operating time: Hr.	Min.	Gas pressure at start Lb.	Operation holding Lb.	Time to reach holding Temp. (380° F.): Hr.	Min.
5- 5-26	2,680	1,630	4,310	5,140	4	30	4	2	2	15
5- 7-26	.....	2,250	2,250	700	6	....	4	2	1	45
5-10-26	.....	7,300	7,300	7,200	8	....	4	2	2	....
5-18-26	.....	7,300	7,300	6,300	7	....	4	2	2	....
5-21-26	.....	14,600	14,600	10,000	8	....	4	2	2	....
5-26-26	.....	15,710	15,710	7,820	7	10	4	2	2	....
5-27-26	.....	17,200	17,200	6,030	6	....	4	2	2	....
6-11-26	.....	34,300	34,300	5,580	7	....	2	1½	1	15

Note.—The operating time varied in the above tests with the size of the cores being dried. In some instances large cores had to be run twice to thoroughly dry them. Usually the car was loaded with both partially dried and wet or green cores and in only one instance (5-5-26) were oil sand cores dried with compound cores. On June 11, 1926, one large core weighing approximately 34,300 pounds which had been partially dried was completely dried. Therefore, it did not require as much time or gas to reach the holding temperature.

and the temperature held at approximately 375 degrees Fahr. for 2 hours longer when the gas was turned off. During the 30-day period when this oven was operated 266,000 pounds of cores were dried with 241,112 cubic feet of gas, or each ton of green cores required 1813 cubic feet of gas to dry them. The following conclusions were arrived at:

The operating time should never be less than four hours and when the oven is cold ½-hour should be added to the time of operation.

Operating time for various loads: 6000 to 8000 pounds wet oil sand cores 4 to 4½ hours, 8000 to 10,000 pounds wet oil sand cores 4½ to 5 hours, 10,000 to 13,000 pounds wet oil sand cores 5 to 5 hours, 10,000 to 13,000 pounds wet oil sand cores 5 to 6 hours.

The second test of the oven without insulation was made during the month of April, 1926. The dried cores were largely oil sand and a few compound. Table 1 is a tabulation of the operating data secured. On April 7, 1926, approximately 4500 pounds of oil sand cores and 142 pounds of compound cores were dried, the total weight of cores dried being 4642 pounds. The weight of cores dried was determined by weighing a cubic foot of oil sand and compound and after measuring each core, its volume was determined, and then the weight was calculated.

To dry this amount of cores 4870 cubic feet of gas, having a heating value of 550 B.t.u. per cubic foot were used. Four hours were required to dry the cores with a 5-pound starting pressure, which decreased gradually as the temperature increased. Two hours and 45 minutes were required to reach a temperature of 380 degrees Fahr. and a holding pressure of 3 pounds. The temperature of the oven 10½ hours and after the gas was shut off was 148 degrees Fahr. This temperature unquestionably would have been greater if the oven had been insulated.

The insulated oven was operated and the data secured is shown in Table 2. The cores dried in this oven were made of compound and often were large, which meant the the car usually contained partially dried cores and wet cores. Most of the large cores require two heats to dry them. Under these conditions it is impossible to compare the results of the uninsulated oven with the insulated oven.

The value of insulation is demonstrated in Fig. 3, which is a curve showing the rate of temperature rise for each oven. The dotted curve represents the rate of temperature rise for the insulated oven and the continuous line the rate of temperature rise for the uninsulated oven. The insulated oven reached the holding temperature about 45 minutes sooner than the uninsulated oven.

When gas first was used in these ovens, one was heated by a tunnel which ran the full length of the oven under the car track. The top of the tunnel was checker bricked, allowing the heat to come up through and around the car load of cores. The tunnel burner was given a thorough test and finally replaced by the manifold burner. The following results were obtained by using the tunnel burner: Cores directly over the tunnel were burned; cores on both sides of the oven were often green after heating; the core oven car was badly warped on account of being directly over the tunnel; the oven was not uniformly heated; the fuel consumption was high.

All of the above unsatisfactory results were eliminated by the installation of the manifold burner as shown in Fig. 2.

Receives Grand Award

A GRAND Prix in the technical press section was awarded the exhibit of the Penton Publishing Co., Cleveland, at the French foundry exhibition which was held in Paris, Sept. 7 to 10. The exhibit was arranged to illustrate the intimate relationship between modern business publications and the industries which they serve. The display was based on copies of the Penton publications, especially THE FOUNDRY and also *Iron Trade Review, Daily Metal Trade, Abrasive Industry, Marine Review* and *Power Boating*.

Book Review

Clays, Their Occurrence, Properties and Uses, by Heinrich Ries, 613 pages, cloth, 6 x 9 inches, published by John Wiley & Sons, Inc., New York and furnished by THE FOUNDRY, Penton building, Cleveland, for $7, and by the Penton Publishing Co., Ltd., Caxton House, Westminster, London, for 35s.

Within recent years the foundry industry has awakened to the fact that one of its major problems is sand. With this awakening has come a desire for a better understanding of the properties and the performance of this most essential substance in foundry practice. Study and research has enabled the foundryman to select his sand more intelligently, prepare it properly for a particular use and to reclaim a greater portion of it after it has passed through the preparing, molding, pouring and shakeout cycle.

Along with increased information on the preparation of sand has come greater knowledge of the elements which constitute the various kinds of foundry sands. It has been found that clay is one of the most important elements, and for that reason the foundryman, who is at all interested in his sand problem must be interested in obtaining further information on clays.

This volume is the third edition by Mr. Ries, the second edition having been published in 1908. Since an enormous amount of material on the subject of clays has been published since the second edition, the author has found it necessary practically to rewrite the work. The arrangement of the material remains practically the same except that the sections on mining clays and manufacture have been omitted, and in the areal treatment of clays, Canada has been added. A special section also has been added on bentonite.

The first section of the book is devoted to a discussion of the origin and occurrence of the various types of clays, and is followed with a treatise on the minerals in clays. An important section of the book is that devoted to a discussion of the chemical and physical properties of clays. The information presented in that section of the book explains many of the phenomena resulting from the pouring of molten metal into the green sand mold. In a chapter on kinds of clays, the author sketches briefly the characteristics of clays employed for different purposes. The last section of the book is devoted to a discussion of the distribution of clays in the United States.

The foundryman who wishes to add further to his knowledge of clays will will find this book exceptionally valuable. For a number of years the author has been a member of the joint committee on molding sand research of the American Foundrymen's association and also has been chairman of the subcommittee on tests, thus being thoroughly familiar with the problems facing the industry. A part of the equipment used in the A.F.A. sand tests was developed under his direction.

George L. Drake has been appointed agency sales supervisor of the hoist division, American Engineering Co., Philadelphia.

Bill Recalls Hallowe'en Pranks

By Pat Dwyer

TODAY while passing some of the store windows I was reminded by the witches and warlocks, black cats and pumpkins that the jolly, old festival Hallowe'en once more is in the offing. If I were pinned down to explain the origin and meaning of the word offing, I am afraid I should have to take the count, but I have seen and heard the word so often that it seems to come to mind naturally when reference is made to something within the range of vision, either real or imaginary. Some day, perhaps, when I have time, I shall look the meaning up in the old family dictionary—if I can find it—the dictionary I mean—and then perhaps to my dismay I shall find that I have been living under a misapprehension all these years.

Naturally, I shall be more careful of the application of the word in the future, but what of all the times I may have used the word mistakenly in the past? Ah! sez you, there's the rub. However, the consolation always remains that since I have forgotten when, where, why and how I may have used the word, the chances distinctly are in my favor, that those who have heard or seen me committing the error, also have forgotten all about it. Fortunately, the average reader has a remarkably poor memory.

For the benefit of any doubting Thomases I need only propose a simple test. Go to any picture show and notice the behavior of the spectators when the strip of current jokes is shown on the screen. Those that are new only elicit mild interest, but when a hoary old veteran appears, one that has been going the rounds of the newspapers and the vaudeville stage for years, the house rocks with merriment. I sat behind a woman the other night who nearly had a convulsion at a Pat and Mike joke that to my certain knowledge was at least of voting age at the time I was learning to read. The captious critic may claim she never may have heard or seen it before. To which I reply Bah!—just like that—Bah! If she hadn't she must have been born deaf and dumb and brought up in an asylum for the blind. No, I will not tell you what it was. I was brought up to respect old age.

Well, well, I hear you say, perhaps a trifle impatiently—some people are in *such* a hurry—what about Hallowe'en? Quite right, my dear, you are perfectly within your rights in asking the question. Indeed, I should show a singular lack of appreciation of my dear public if I so far forgot myself as to start discussing one subject and then for no apparent reason, switch to another. Perish the thought and—er—so forth. Nothing indeed was farther from my mind.

I merely wanted to make my position clear in the use of the word offing. Sometimes—Oh! well. All right, all right—Let it go this time, but—

All this preparation for Hallowe'en and the manner of celebrating the festival in a city caused me to wonder if the same custom has invaded small towns or if they still whoop 'er up in the manner to which they were accustomed when I was a boy.

Probably they all are alike by this time. Rapid communication by rail, bus and automobile; universal introduction of the telephone, telegraph, radio and moving pictures, practically have wiped out the differential that at one period existed between small and large communities. Pictures of a recent fashionable wedding solemnized near the head waters of the St. Maurice show that the sturdy habitants of Quebec have discarded the heavy Mackinaw jacket, the *ceinture fleche* and the *bottes sauvage* for the modern garments supplied by Eaton's Ltd., to the sophisticated inhabitants of Toronto and Montreal. Bobbed hair is as prevalent in the so-called hinterland as it is on Fifth avenue where the ladies go forth to take the air, or anything else on which they can lay their dainty paws.

Taking it all-in-all, the world is a better place in which to live and I would not go back willingly to the hand pump, the horse drawn vehicles and the tin wash basin in the back kitchen. However, the time and the place also had their compensating features and one of these was the manner of celebrating Hallowe'en.

The central feature was a bonfire and the most intense rivalry existed between gangs from different sections of the town to see which could put on the greatest and most spectacular fire. A hill, locally known as *The Mountain*, gave the boys at the north end an advantage in that their fire could be seen and admired—perhaps—from every part of the town. The fact that the erection of the pyre at this point involved days and nights of weary back breaking toil, dragging, rolling and pushing empty barrels and packing cases up the hill never was

A HOT TIME IN THE OLD TOWN TONIGHT

taken into consideration. If, on occasion, a weak kneed member ventured to protest he was promptly given a bigger load and told to keep his silly mouth shut.

Usually but not invariably, the boxes, barrels and other combustibles were secured with the consent of the various owners. In some instances discarded mattresses filled with straw were donated cheerfully. These mattresses almost invariably had been thrown out because—well, let us say for good and sufficient reason. With a sublime disregard for consequences that would give their house keeping mothers heart failure, the boys shouldered these homes for the homeless and dragged them off to the fire. If there is a more awkward load to handle than a mattress in this wide world, I have yet to see it.

A boy's conscience is a tender and beautiful thing, probably because he never uses it. That is the only explanation I can give for the almost total disregard we showed for sacred property rights on Hallowe'en nights in the long ago. Looking back now, it seems incredible that boys living in a civilized community, sons of peaceful and law abiding parents, boys ordinarily amenable to discipline and brought up with a proper regard for the rights of others, should throw all restraint to the winds and behave for one night in the year like a band of guerillas raiding an enemy's territory.

Perhaps the fire was responsible. There is something about a blazing conflagration that arouses dormant atavistic instinct and desire in the human mind. Even today, the clang of a gong and the screeching wail of a fire engine siren arrest the attention of the blase inhabitants of the most populous city and cause little anticipatory thrills at the nerve centers. Only the most heroic self restraint enables the average citizen to resist the temptation to follow the apparatus to the five.

Of course, the more susceptible make no attempt to resist the impulse. They dash to the scene, all keyed up with excitement and revel in ecstasy, thrills, water, cinders and smoke until the last wall has fallen and the last spark has been extinguished. I know of one private citizen here in town with such an uncontrollable passion for fires that he has had a gong connected with the nearest fire station, installed in his house. The instant the bell rings, day or night, he is up and away like a jack rabbit to work like a fiend, half drowned, dragging heavy hose up and down ladders and smashing in doors and windows with an axe.

Labor incident to building the fire and afterward poking it up in good shape, kept the gang busy for an hour or two, then the crowd broke up into parties of two and three and worked zealously until midnight in a valiant attempt to turn the town inside out. Gates were lifted from their hinges and hung up in trees. Rain water barrels were rolled around from the back yard and tipped against the front door in such a manner that when the innocent householder opened the door in answer to a peremptory knock, he received an involuntary bath. At the risk of broken necks, boys scrambled up roofs and stuffed bags down chimney tops.

THREE OF A KIND BEATS ONE STAIR

Nothing was safe. The ornate pestle and mortar of the local druggist was set up in front of an undertaking establishment, while the druggist was properly horrified in the morning to discover a sign in front of his place of business announcing that he was equipped with all the latest appliances for handling post mortem cases with quiet dignity and elegance. The sign from a blacksmith shop was hung upon a boot and shoe store and a wooden Indian was carried from one end of the main street to the other end and set up in front of a little candy store kept by an old maid who believed that tobacco was an invention of the evil one and that those who used the pernicious weed were no better than the inhabitants of Sodom and Gomorrah.

Bill came in tonight to show me a letter he had from a lively young lad 80 years of age who still lives in the little town where we served our time. At that time after the manner of youth I had considered him an old man and lacking any contact with him since I naturally and carelessly assumed that he had departed for the molder's paradise—if there is such a place—many years ago. Bill's somewhat astonishing news that the old boy still is living made me realize how our viewpoint changes with the years.

At sixteen we think any person over fifty is tottering on the brink of the grave. At thirty we feel that any person over sixty cannot expect to remain much longer. At forty when we are grown up and in a position to view people and conditions from a proper perspective we admit that a man of seventy or seventy-five is getting along. When we arrive at the half century mark and take a tentative peep or two down the far side of the hill we regard a man of ninety as well up in years, but given an even break, he may attain a century.

Reference to the gallant old lad and the old town coupled with my own reflections during the day prompted me to ask Bill if he remembered our youthful, wild and hilarious Hallowe'en nights.

"Remember?" said Bill. "I'll say I remember. I got a broken leg out of one Hallowe'en party that laid me up for three months. All the sympathy I had from the man on whose premises the accident happened was 'It's a God's mercy and ten thousand pities you young villain, that you didn't break your little yellow neck!'

"I had forgotten about that," I admitted.

"Sure," said Bill, "You would forget about it. It wasn't your leg. If you had to lie on the broad of your back for a couple of months with a brick hanging from your toes, you wouldn't have forgotten the experience."

"Something about putting a goat upstairs in the town hall, wasn't it?"

"No," said Bill with a reminiscent grin. "That was another time. The only unpleasant feature of that adventure was that I smelled like a goat's nest for a week afterward. People were not as shy then as they are now in telling a fellow why he can't get a date, why he can't hold

a job or why the president never calls him into conference. Every person I met told me what was wrong. Even members of my own gang made a great show of holding their handkerchiefs to their impudent noses. For the good of the service I was obliged reluctantly to bump a few beaks and that gave the owners something else to occupy their wandering attention. A good, swift rap on the snout is a wonderfully convincing argument.

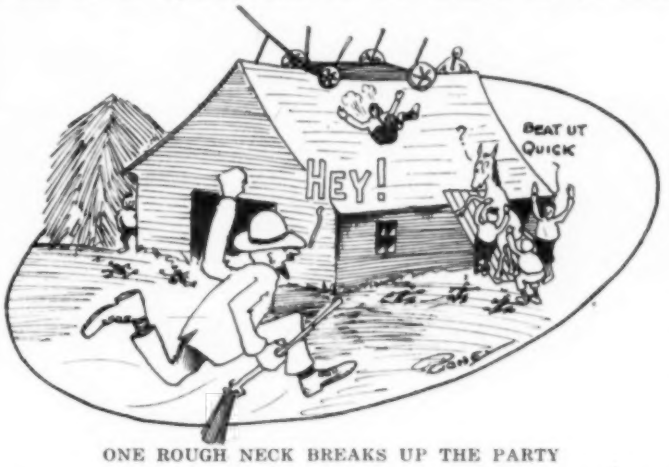
"I broke the leg by falling from the roof of old Davy Patterson's barn, after as fine a job as you ever saw of dragging an old sloven up and placing it astride of the ridge pole. Remember the underslung, one-horse trucks employed in those days for hauling stuff around the town? This one must have weighed half a ton and involved about two hours of the most superhuman effort on the part of the gang assisted by a block and tackle before it was perched safely on the pinnacle. Despite our most earnest attempt at secrecy the noise finally brought old Davy charging out with a shot gun. He was a retired shipmaster with a reputation for maintaining discipline with a gun or a belaying pin —which ever came handiest—and we wasted no time with a parley or a flag of truce.

"The gun might have been loaded only with salt or bird shot, but for all we knew to the contrary it might have contained a handful of slugs and old horseshoe nails. A leap from the roof was preferable to waiting to find out. The gang jumped in all directions and escaped. I slipped and broke by leg.

"Funny how the element of chance enters into nearly all our activities. In this instance a dozen boys took equal chances and I was the only one to meet an accident: It is the same way in the foundry. A man may make a dozen identical molds and one of the castings may be a waster. Sometimes the conditions are reversed and only one casting out of the dozen will pass inspection.

"I was talking to a man the other day who said he was preparing to make water jacketed exhaust manifolds for a gas engine and on the few preliminary castings poured he found that the chaplets did not hold the inside core and the jacket core in their proper relative position. The mahogany pattern was designed to be molded in the ordinary manner with the three openings in the bottom. He had placed seven ⅛-inch stem chaplets, staggered on the bottom to support the jacket core; four ⅛-inch stem chaplets in the cope on top of the jacket core. He had used seven or eight 22-gage perforated chaplets between the inside core and the jacket core.

"He said he was undecided whether it is necessary to pour the casting with two ladles through gates on opposite sides, or to continue as he had been doing, pouring it through a single set of gates from one ladle. He would appreciate an expression of opinion both on the method of gating and the proper type of chaplet to employ to insure sound castings.



ONE ROUGH NECK BREAKS UP THE PARTY

"Without a personal view of the job and basing an opinion merely on the information supplied, I claimed the trouble might be due to faulty design either of the pattern or corebox. Manifolds vary in shape and it may be that this is one in which the iron has a tendency to roll the core as well as lift it, thus dislodging the chaplets. I assumed that the cores were made good and stiff and therefore he had no spring to contend with in addition to the usual *lift* on the core.

"The fact that he placed seven chaplets on the bottom and only four on top led me to infer that he under-estimated the lifting pressure exerted by molten iron. Chaplets on the bottom are only required to support the weight of the core, possibly 10 or 12 pounds. Chaplets on the top must resist a pressure equivalent to the displacement of the core multiplied by the height of the pouring head.

"Thus on a manifold casting 25 inches long, approximately 3 inches in diameter and with the top of the gate 6 inches above the bottom of the core, the lifting pressure on the core is approximately 100 pounds. This pressure is released almost immediately on account of the metal setting, but it is present for a few seconds and any scheme of chapleting adopted must be designed to meet it.

"Perforated, tinned chaplets supplied by foundry equipment houses may be used between the inside core and the jacket core, but stem chaplets are to be preferred on the outside of the jacket core, both top and bottom. Short stem chaplets, inserted in holes in the pattern and rammed up in the drag will support the core on the bottom, but on account of the comparatively heavy *lift* as already pointed out, on the core, the chaplets on top must be held securely and rigidly in some manner.

"The usual method is to adjust the cope bars in such a manner that a flat spot, or a button, comes immediately above each point where a chaplet is required. Thus, after a cope has been lifted off, a chaplet is inserted in the sand at each point until the end of the stem comes into contact with the flask bar and the remainder of the chaplet protrudes the proper distance to engage the core after the cope is returned to place on the drag. The chaplet is held in place by pinching the sand around it with the fingers, or by slicking the sand with a tool. The chaplets are quite light and little support is required to hold them in place. Fairly deep core prints on the pattern in which the cores fit snugly, assist materially in holding the cores in place.

"On account of the fact that the casting must be water tight and with the metal solid in the vicinity of the chaplets, it is safer to use two ladles than one and pour the metal from gates on opposite sides of the mold. Walls of the casting are so thin that cold shuts will develop unless the mold is filled rapidly with exceedingly hot fluid iron. The runner on the straight side may be connected to the mold through eight or ten flat, shallow gates, spaced about one inch apart. The runner at the opposite side may be located between two of the brackets and connected to the mold through three branches, one to the main body and one to each of the brackets."

W. H. Finkeldey has resigned his position as assistant chief of research, New Jersey Zinc Co., New York, to become associated with the firm of Singmaster & Breyer, consulting chemical and metallurgical engineer at 420 Lexington avenue, New York.

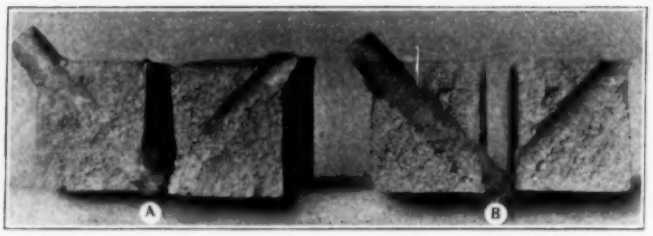


Fig. 1—Untinned Chaplets Cast in Test Mold

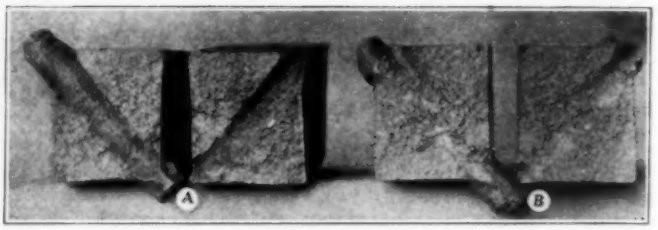


Fig. 2—Tinned Chaplets Cast in Test Molds

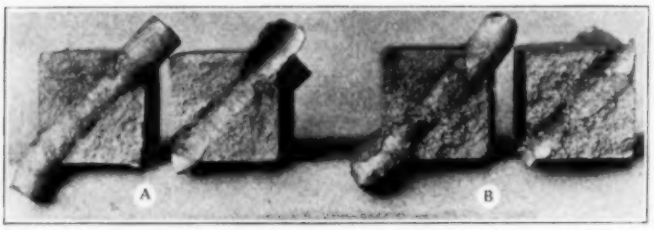


Fig. 3—Untinned Chaplets Cast in Test Mold

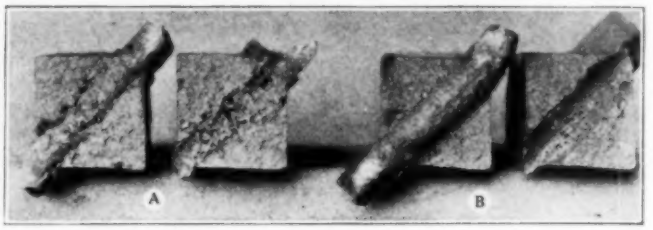


Fig. 4—Tinned Chaplets Cast in Test Mold

Studies Use of Chaplets

By Jacques Varlet

TO DETERMINE the difference between chaplets coated with tin and chaplets of mild steel, which may represent either double chaplets or bar chaplets either of small or large dimensions, used in cored castings for wedging and supporting the cores, the following experiments were undertaken.

1. Bars 0.472 inch in diameter coated with tin and similar untinned bars were placed in square test molds 1.969 x 1.969 and 1.575 x 1.575 x 7.87 inches.

2. The molds were made for top pouring in the test shown in Figs. 1, 2, 3 and 4.

3. The test pieces marked *A* in each illustration represent the bars placed in the molds into which a volume of iron suitable for engineering purposes representing a weight of 154 pounds was poured for 1 minute from small hand ladles, the mold being kept continuously filled.

4. The test pieces marked *B* formed part of the same flask and were connected to the *A* test piece by a bottom gate. They were therefore subjected to the same operation and received the same quantity of metal, but by bottom pouring. Fig. 5 shows the method of making the test pieces.

Figs. 1 and 3 are those in which the chaplets were untinned, while Figs. 2 and 4 show chaplets coated with tin.

Numerous tests, made with the greatest care, showed that the tinned bar fuses badly and produces a large number of blisters at the junction of the iron with the tinned part, as may be seen from the illustrations shown in Figs. 2 and 4.

The test pieces which were cast directly, that is by top pouring, are not as good as those which were bottom poured in accordance with the diagram of Fig. 5. This test shows that by direct pouring, notwithstanding all the precautions taken to keep the pouring gate and the mold con-

JACQUES VARLET was born at Liege, Belgium, in 1872. At the age of 12 he entered the foundry industry as an apprentice in an important works in the Liege basin. The following years were spent in various leading shops in perfecting his knowledge of foundry operations and in 1891 he became manager of a foundry. His career as a foundryman covers 43 years of service, of which 36 years were spent as the head of a foundry. The principal establishments which he has managed are as follows: Les Fonderies et Acieries de Roux (Hainaut), Les Fonderies SAFAK *a* SCLESSIN, *Les Fonderies de fonte, bronze et acier de la Societe Metallurgique d'Esperance-Longdoz a Seraing.*

He has managed the foundry of the latter company since 1908. Mr. Varlet always has been especially interested in improving the foundry art. Through the Association Technique de Fonderie de Belgique, of which he is a charter member, he has added much to the industry through papers, giving the industry the benefit of the knowledge and experience he has acquired through long practice. He has been vice president of the Association de Technique de Fonderie de Belgique since 1913. Mr. Varlet is a Chevalier of the Order of Leopold.

Table I

Analysis of Chaplets

	—Before Pouring— Tinned steel	Untinned steel	—After Pouring— Tinned steel	Untinned steel
Silicon	0.085	0.005	0.141	0.141
Manganese	0.428	0.428	0.370	0.340
Sulphur	0.032	0.040	0.064	0.048
Phosphorus	0.095	0.080	0.243	0.220
Carbon	0.070	0.080	0.070	0.080

Remarks: There was no recarburization as a result of contact with metal, but there was an increase of silicon and phosphorus.

Table II

Analysis of Chaplets

No.	Silicon	Before Pouring Manganese	Sulphur	Phosphorus
1	2.00	0.6	0.05	1.4
2	1.75	0.5	0.06	0.5
3	1.40	0.45	0.07	0.045
No.	**Silicon**	**After Pouring Manganese**	**Sulphur**	**Phosphorus**
1	1.87	0.5	0.06	1.07
2	1.75	0.5	0.07	0.55
3	1.40	0.48	0.075	0.15

tinuously filled during casting, air is drawn into the mold and oxidation thus takes place on contact with the iron. With all the precautions taken to prevent the admission of air into the molds, and particularly when the pouring period is fairly long, nevertheless it appears that the first entries of air are evacuated completely in 10 to 15 seconds. However the same defect is reproduced at each test, whereas it is not produced by bottom pouring except on test piece *B* of Fig. 1, where it is insignificant in comparison with the tinned and untinned irons obtained by direct pouring. The analyses of the chaplets are given in Table I.

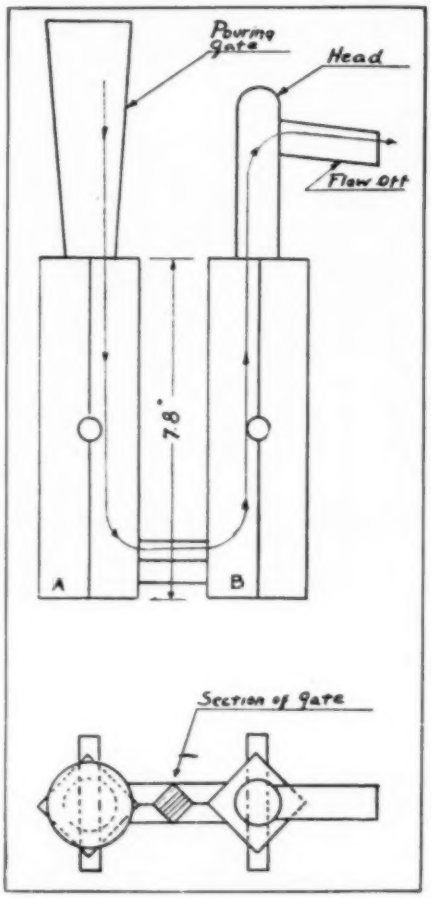


Fig. 5 (Left)—Diagram Showing Method of Pouring Test Molds

Fig. 6 (Right)—Cross Section of Bars in Test Piece

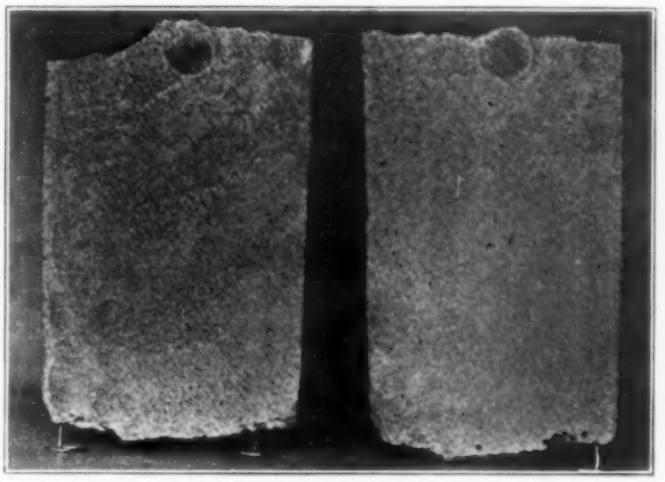


Fig. 6 represents two of the *A* test pieces of Figs. 1 and 2 cut in wedge form to show the cross section of the bars. The first is that of the tinned bar and the second that of the untinned test pieces. It will be observed that the untinned piece has a better appearance and fuses better than the tinned.

From these repeated tests it may be concluded:

1. That when tinned chaplets, double or with bars, are used, they must be of good manufacture, and that the steel must be pickled before the chaplets receive the tin coating.

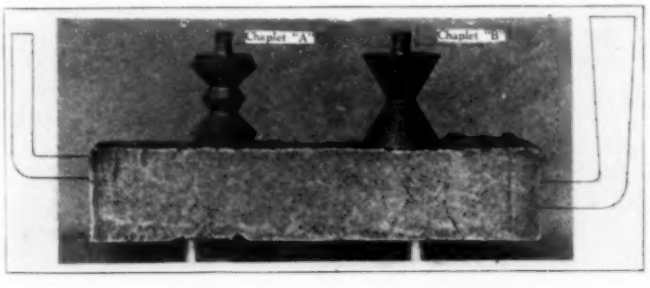
2. That if untreated bars are used as chaplets, particularly with bars, they must be well cleaned and must have all the oxide scale removed before use. This work must be carried out so that the bars may be placed in the molds with the minimum of delay before pouring.

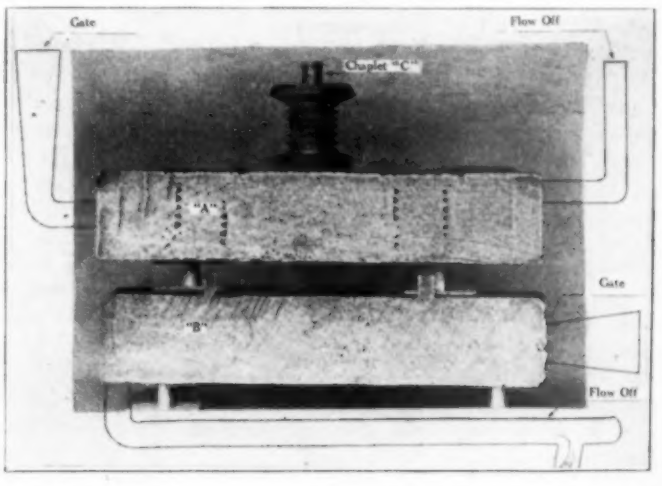
The tests show a marked advantage of the polished steel over tinned steel, even with pure tin, for it fuses much better and does not produce the blisters formed by the tinned bars. Iron suitable for engineering purposes was used. The chemical characteristics were as follow:

Silicon 1.80, manganese 0.6, sulphur 0.07, phosphorus 0.3. Its physical characteristics were as follows:

Shock test piece: height of drop

Fig. 7 (Below)—Special Test Was Made With Various Types of Chaplets. Fig. 8 (Right)—Poor Welding Resulted With This Chaplet





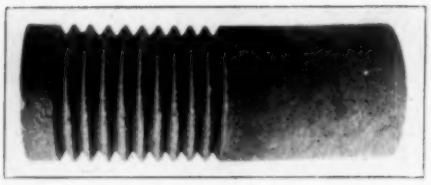


FIG. 9—CHAPLET USED TO HOLD CORE OF HYDRAULIC PISTON

23.62 inches with a 26.5 pound tup. This gave the following results after 8 shocks repeated at intervals of 1.97 inches:

Initial height of drop.....9.84 inches
Rupture .....23.62 inches
Number of shocks 8
Strength per square inch of section .....5439 pounds per square inch.

These particulars are given to show that the metal used in the tests was such as to give every possible guarantee that satisfactory results would be obtained.

Cast Iron Chaplets

The same tests were repeated on cast chaplets of various forms as shown in Figs. 7 and 8. The cast chaplets *A* and *B*, Fig. 7 were placed in the 1.575 x 1.575 x 7.87-inch test mold.

The test was poured horizontally with a volume of metal amounting to 44 pounds, the metal issuing from the mold by a riser and flowing through the riser until 44 pounds of metal had been poured into the test piece. It will be seen that these two chaplets are almost completely fused, particularly *A* of Fig. 7.

The chaplet of the form *B*, Fig. 7, frequently is adopted by inexperienced founders. This type chaplet should not be used, for, although it shows a suitable surface at the two ends for supporting the cores, the center of the chaplet, forming two cones, cracks and the two conical parts may separate from the casting under the influence of shock, vibration or pressure.

While the illustration does not indicate a crack in the center, with the aid of a magnifying glass it was possible to detect narrow cracks on the casting caused by the contraction, which are the beginnings of rupture. Chaplet *A* is embedded in the metal with the maximum degree of adherence owing to the six conical parts with which the chaplet is provided.

Fig. 8, test piece *A*, was cast in the same manner as that in Fig. 7, with straight chaplets of the same metal and the same weight.

The illustration indicates poor welding between the metal and chaplet. This shape also is not to be recommended, particularly for light and thin castings.

Test piece *B* is top poured with the same chaplets and a volume of metal of 154 pounds. It will be noted that it is perfectly fused and that the result is excellent. Test pieces were cast in the same manner with chaplets *A* and *B* of Fig. 7, and the same result was obtained.

It should be noted that the numerous chaplets tested were of different metals, their analyses being as follows:

No.	Silicon	Manganese	Sulphur	Phosphorus
1.	2.56	0.642	0.024	1.63
2.	2.00	0.870	0.040	0.50
3.	1.40	0.700	0.040	0.045

We found that the No. 1 chaplets fused admirably owing to the low melting point of the metal and its phosphorus content.

No. 2 also behaves fairly well and is stronger when the thickness is considerable, while No. 3 scarcely welds at all owing to the purity of the metal and the high melting point of hematite iron. Table II gives the analyses before and after pouring.

The analyses shows that there has been a loss of silicon and phosphorus in No. 1. No. 2 has remained approximately the same. No. 3 has been affected by the phosphorus of the metal poured. The analysis of the metal used for pouring on these chaplets was silicon 1.7 per cent, manganese 0.7 per cent, sulphur 0.07 per cent and phosphorus 0.95 per cent.

Fig. 9 represents a chaplet used to hold the core of an hydraulic piston, as shown in Fig. 10. The height of pouring head is 13.12 feet. Notwithstanding this height of drop, the chaplets, which were of hematite iron, did not weld, and they were withdrawn from a broken casting, as shown in the illustration.

These tests show that cast iron chaplets must be adapted to the character of the castings—their thinness or thickness, the volume of metal to be poured into the mold, the rapid or slow flow of the metal in contact with the chaplets, the volume and weight to be supported, etc. The author is convinced that chaplets of mild and high phosphorus cast iron, such as No. 1, will not stand long the continuous flow of a metal at a temperature of 2100 degrees Fahr., for example. They will be completely melted in a minute and will be of no further use, except in the upper parts of the mold, where the flow of the metal is less constant and of shorter duration. On the other hand, the chaplets of the analysis of No. 2, being more refractory, soften more slowly and are welded to the casting metal after a period of time.

The chaplets having the analysis of No. 3 can be used only for castings of great thickness and requiring heavy cores. However, the repeated tests show that this metal fuses with difficulty, even when the flow of the metal is continuous. It is nevertheless useful, and should be used for certain castings which are subjected to great stresses.

Generally speaking, the founder must calculate—apart from the character of the metal—the dimensions of his chaplets, for their volume must be proportional to the volume and weight which they have to support, and particularly to the quantity of the flowing metal or the volume with which they are surrounded.

One must judge approximately

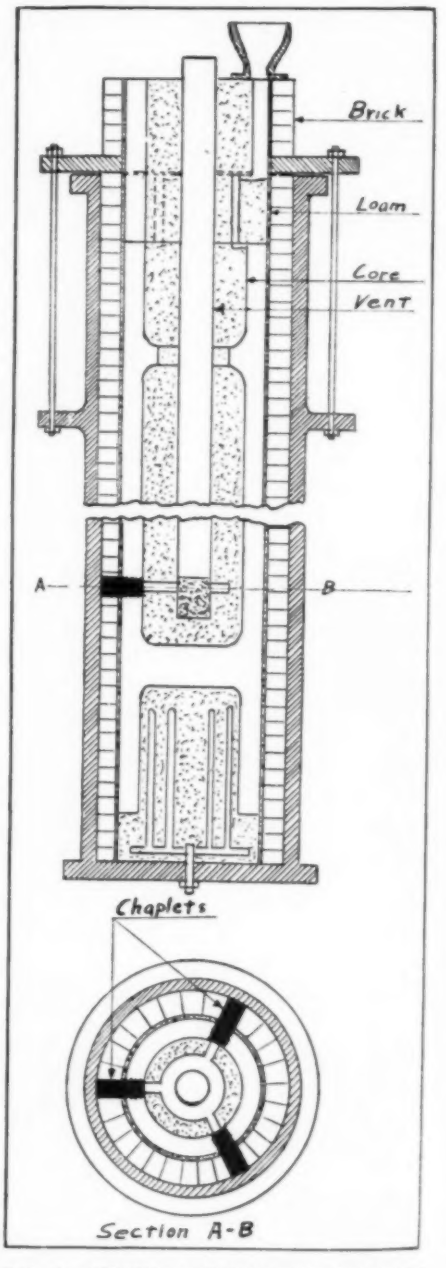


FIG. 10—METHOD OF PLACING CHAPLET IN HYDRAULIC PISTON CORE

A LEXICON OF TECHNICAL TERMS

By O. W. Potter

(*Continued from Data Sheet No.* 690)

Modulus of Elasticity in Tension (*Young's Modulus*)

The ratio of load to deformation or unit load to unit deformation below the elastic limit when stressed in tension.

Examples:

Material	Modulus in Tension
Wrought iron	25,000,000
Mild steel	30,000,000
Cast iron	7,000,000-16,000,000
Malleable iron	25,000,000

Modulus of Torsion

The ratio of load to deformation, unit load to unit deformation, below the elastic limit when stressed in torsion (twisting).

It has been found that torsion produces failure by shear and therefore the modulus of torsion is the same as for shear.

Examples:

Material	Modulus in Torsion
Wrought iron	10,000,000
Soft steel	12,000,000
Cast iron	6,000,000

Modulus of Flexibility (*Modulus of Specific Extension*)

The stretch in thousandths of an inch on a length of 10 inches under a stress of 1000 pounds per square inch. Its reciprocal times 10,000,000 equals the modulus of elasticity.

Examples:

Material	Tension, inches	Compression, inches	Shear, inches
Wrought iron	0.0004	0.0004	0.001
Steel	0.00033	0.00034	0.0008
Malleable iron	0.0004	0.00045	.....
Cast iron	0.00143-0.00062	.....	0.00166

Modulus of Cubic Compressibility

This is the modulus or the ratio of volume reduction to load applied in a body under equal compressive stresses in all directions. This term is used only rarely in reference to metals and alloys.

(*Continued on Data Sheet No.* 692)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 691)

Modulus of Resilience

The work expended in deforming a unit volume of a material to the elastic limit.

Examples:

Material	Inch-pounds per cubic inch	Inch-pounds per pound
Structural steel	20.4	72.0
Wrought iron	12.5	44.9
Cast iron	1.2	4.6

Modulus of Rupture

The modulus of rupture is the load per square inch on a simple beam which causes rupture as calculated from the flexural formula:

$$S = \frac{Mc}{I}$$

S=Load in pounds per square inch.
c=Distance of neutral axis from outer fiber.
I=Moment of inertia.

This formula is derived from the observations of the behavior of materials below the elastic limit. Rupture always occurs beyond the elastic limit. Therefore this formula is only approximately correct.

It is always a value greater than the ultimate tensile strength.

Examples:

Material	Pounds per square inch
Wrought iron	about 50,000*
Mild steels	about 55,000*
Strong steel	about 110,000*
Malleable iron	about 70,000
Cast iron	about 35,000-50,000

(*) Yield point is taken for the more ductile materials.

Specific Tenacity

The tensile strength of a material expressed as the length of a bar which if suspended vertically is just sufficient to break under its own weight. This is not a commercial test and usually is considered only in technical experimenting.

(*Continued on Data Sheet No.* 699)

THE FOUNDRY DATA SHEET, NOV. 1, 1927

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

whether, according to the dimensions, the chaplets are liable to soften and break or whether they are capable of supporting their load or even fusing with the metal without softening too much. It is therefore a question of the volume of the chaplet. A good result will be dependent upon all these factors.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of THE FOUNDRY or of its editors.

Hold Reunion of A. F. A. Overseas Guests

TO THE EDITORS:—

You will be interested to know that the *Lancastrians*, by which name are known those of the international visitors who attended the Detroit convention of the A.F.A., after crossing on the steamer, LANCASTRIA, held their first annual reunion at the Hotel Continental, Paris, during the recent French convention. M. Leon Montupet occupied the chair. There was a good muster including John Cameron and James M. Primrose, both Carlo and Guido Vanzetti, father and son, and Messrs. E. V. Ronceray, Paul Ropsy, H. Magdalenat, M. Montupet, Jr., Claude Primet and M. Primet, Jr., from France, M. Paul Thome from Belgium, T. J. Brons from Holland, Comm. Antonio Galtarossa from Italy with his brother, and the writer and Mrs. Russell.

The banquet was arranged by M. Montupet, and a pleasing feature was that so many of the *Lancastrians* who were unable to attend sent contributions toward its cost, with a request that they might be allowed to provide wine so that the feast might merrier be. Among the absentees so represented were Messrs. W. B. Lake, S. H. Russell and T. H. Gray of England, Gruson of Germany, Harry Winterton of Scotland, Franco Ratti, Agostino Rocca, Ugo Fano and Amedo Pellicciotti of Italy, and several others. Every person present made a speech interpreted by M. Primet, Jr. aided on occasions by M. Vanzetti, Jr.

The president, M. Montupet, opened the proceedings by, dwelling upon the fact that so happy an international meeting was due, in the first place, to the American Foundrymen's association having invited overseas foundrymen to visit the exposition at Detroit. He recalled the magnificent hospitality received, and amidst loud cheers, and with hearty enthusiasm, the toast of the A.F.A. was drunk, all standing. Other toasts were "Absent friends", "The LANCASTRIA", and "The Foundry Industry."

A specially printed menu produced on cork as a reminder of the life belts we never had to use, bore a picture of the S. S. LANCASTRIA, and appropriate sentiments. This was on Sept. 8, and on the Sunday following M. Montupet invited the *Lancastrians* and some of the exhibition officials to visit his chateau near Versailles.

After lunch the whole party proceeded in cars provided by host and visitors, to the pleasant house of M. Ronceray, where they were received by Madame and Monsieur, and M. Ronceray, Jr. and his charming wife, lately residents of Detroit.

The one thing needful was an international language, but to meet the case the British are learning French, and the French and Italians are learning English, so that the curse of the Tower of Babel may no longer rest upon future gatherings of those who crossed the Atlantic together to rediscover America and found it, as Columbus did, to be "Dry land."

I have written you at this length, my dear Editors, thinking that many of our American friends will be interested to hear of the reunions which have resulted from their hospitality last year, and if you like to publish all or any part of this communication, or make use of it in any way you please, you are very heartily welcome indeed.

FRANK RUSSELL
Worksop, Notts., England

Gas Association Meets

Economics of gas as a fuel in brass melting were discussed in a paper by J. F. Quinn, Brooklyn Union Gas Co., Brooklyn, N. Y., which was read at the convention of the American Gas association held in the Stevens hotel, Chicago, Oct. 10 to 14.

According to the author, development of furnaces for nonferrous melting apparently is the result of cut and try methods. Some furnaces are suitable for melting alloys of certain compositions, but are unsatisfactory with others which shows the need of special furnaces designed to handle them. Zinc has a low boiling point of 1700 degrees Fahr. and distills off during melting of brass, causing loss. Generally, the pouring temperatures of brasses are about 300 degrees higher than the melting points which in a 70-30 brass brings the pouring temperature close to the boiling point with consequent loss of metal due to distillation of zinc. Hence the gas furnace hardly could improve conditions. An approximate rule for engineers or salesmen on problems involving metal loss is: The sum of the melting point plus 300 degrees Fahr. should be less than the boiling point minus 200 degrees Fahr.

In many cases other fuels than gas are more suitable and economical especially in small foundries working 8 to 10 hours a day, and the odd lot foundries. Gas furnaces should be specially designed and not rearranged from former attempts if good results are expected. Hale A. Clark, Detroit City Gas Co., Detroit, pointed out some significant increases in gas usage in heat treatment of steel and in nonferrous work. He cited the Bunting Brass & Bronze Co., Toledo, O., which converted 15 reverberatory furnaces from oil to gas with a monthly gas consumption of 12,000,000 cubic feet. A recent development in the use of artificial gas has been in the cutting of steel and cast iron. Much work along this line has been done by the General Electric Co., Schenectady, N. Y.

Hear Apprentice Talk

At the opening fall meeting of the Newark Foundrymen's association held at Newark at the Downtown club on Oct. 17, William H. Barr, National Founders' association stated that he believed that conditions during 1928 would not be as sluggish as other national election years. The first eight months of this year were dull but within the past 30 days definite signs of improvement were noted. L. A. Hartley, educational director, National Founders' association discussed the problem of building up a permanent working force. He outlined personnel work and emphasized the necessity of foundrymen holding a better appreciation of their own industry if they expect to attract apprentices and keep them interested. Incidentally, the speaker mentioned that the foundry industry was the only large industry in the country that did not advertise itself as an industry. Interest in this direction will lead to a greater business and attract men to the industry.

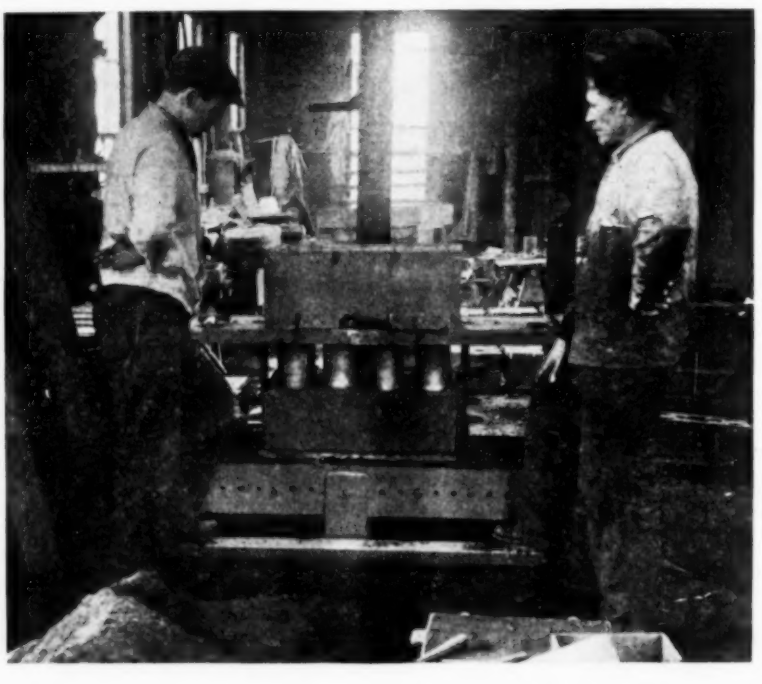
Is District Manager

J. C. Fitzpatrick has been appointed district manager of sales for the Chicago Pneumatic Tool Co., New York. Mr. Fitzpatrick succeeds J. L. Westenhaver who resigned to enter business for himself, and will be located at 1241 East Forty-ninth street, Cleveland.

He Designed Early Type *Molding Machines*

WALTER SCOTT, as you probably remember, in one of his stately passages warns the prospective tourist that if he wants to see Melrose Abbey aright, he must visit it by pale moonlight. That advice may be all right for abbeys and maybe for other kinds of relics, but it would be of little use for any person who wished to interview J. W. Dubois at his foundry, Cold Spring, N. Y. The prospective tourist who had his mind set on having a few words with James would have a grand time touring over nearly all the empire state unless he fortified himself with advance knowledge on which of the Cold Springs he wanted.

New York state is fairly saturated with cold springs, running over, you might say, with them. There is a place of that name in Cattaraugus county, one in Onondaga county, one in Putnam county and another in Steuben county. Just to make the problem a little more interesting the postoffice recognizes two Cold Spring Harbors, one in Suffolk county and the other in Nassau county. If that is not enough to make a visitor watch his step, there is a Cold Water in Monroe county and two Cold Brooks, one in Herkimer county and the other in Ulster county. No wonder the state usually is classified as wet.



Cold Spring, Putnam county, was the town selected by James W. DuBois about 18 years ago when he decided to go into the foundry business on his own account and that is where he has been engaged actively since that time in a general jobbing line, also in the manufacture and exploitation of articles on which he holds patents up to the number of eighty. In the illustration at the top of the page he is shown with a portable automobile windlass, one of his most recent inventions. The illustration at the bottom of the page shows an exceedingly early model rollover pattern draw machine which he built over 20 years ago.

In one capacity or another Jim has been intimately associated with the foundry industry almost from infancy. He was born in Stockport, Columbia county, New York, Jan. 13, 1869, in a house directly across the street from a little foundry under the charge of his father, Wiliet DuBois, a prominent all-around foundryman of the time and place. Later his father found employment in the malleable foundry of I. G. Johnson Co., Spuyten Duyvil, New York, and here the boy learned the molding trade beside his father in the years between 1885 and 1893. In the latter year he secured a job as molder with the J. B. & J. M. Cornell Co., 26th street and 11th avenue, New York city, and gradually was promoted to more responsible positions and finally was appointed general superintendent over the foundries controlled by this company in New York city and Cold Spring, N. Y. During his 14 years connection with the J. B. & J. M. Cornell Co., he developed many labor saving and cost cutting devices and methods and was one of the first jobbing machinery foundrymen to try out the molding machine. Following interviews with John Tabor, Philadelphia, and Henry Pridmore, Chicago, he designed and built the rockover molding machine shown in the accompanying illustration in which a treadle under pressure of the operator's foot actuates a toggle lever and lifts the patterns out of the drag.

In 1907 he severed his connection with the foundry company to accept a position with a youthful organization which in later years has become widely known as the Pangborn Corp., Hagerstown, Md. He remained in this position

(*See Page* 868)

Milestones in Foundry Progress

As Recorded in the November Issue of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

1897

HENRY HANSEN, writing for THE FOUNDRY in the issue of November, 1897, pointed out the bad habits to which molders were addicted, referring, of course, to practices followed in their work. He mentioned the lack of definite knowledge on gating requirements and gave examples of failures encountered directly through this ignorance.

* * *

We are reminded of the story of Coal Oil Jimmy. He could not make a good mold without employing some of the fluid with which we are favored, through kindness of Mr. Rockefeller. Jimmie did not always have that habit, but one day some one suggested that he spray some coaloil on the mold he was making. The casting came out good and after that Jimmie couldn't get a good casting unless he sprayed the mold with coaloil.

HENRY HANSEN

* * *

Jobbing and speciality foundries alike were busier than they had been for years. Many were contracted to their full capacity.

* * *

The Trade Journals Review, Manchester, England, in a communication expressed a doubt as to whether it was possible to melt a mixture of 20 per cent steel, 20 per cent pig iron and 60 per cent iron scrap in the cupola, as had been stated in a previous issue of THE FOUNDRY.

* * *

The editor in reply suggested that perhaps semisteel then was unknown in England. Might it not have been called "fontoid" or "fantods" or whatever it was once proposed as an alias for semisteel?

* * *

All kinds of people have taken a hand at running a foundry. I once knew a preacher and a woodturner who pooled their issues and started a foundry. They busted up. I learned afterwards that the woodturner never amounted to anything at his own business and the preacher had only been able to earn twelve dollars a month, which showed he was not worth much in his trade either—some even went so far as to say this was twelve dollars more than he earned. Those people would have busted if they had started a bank.

KRANK'S KORNER

* * *

A. E. Outerbridge, William Sellers & Co., Inc., Philadelphia was awarded the Scott legacy premium and medal by the Franklin Institute for his work on the molecular physics of iron.

Faked Foundry Facts

A Dirty Face

1907

CASTING sash weights in chill molds was attracting attention in 1907 even as it is today, as is shown by an article in THE FOUNDRY for November, of that year. A complete description, with illustrations, covers the operation of a water cooled permanent mold system.

* * *

P. R. Ramp was contributing interesting articles on detailed molding practice.

* * *

An article by E. F. Lake gave practical advice on making brass castings for automobiles.

Twenty years ago the brass castings used in automotive service included glands, nipples, pet cocks, valves, carburetor bodies, levers, brackets, supports, valve caps, pumps, by-passes and strainers. Remember the multiplicity of bright brass fittings on the windshield, lamps and body trim that had to be polished? But such brass fittings did stand up.

* * *

W. M. Carr contributed an interesting discussion on the relative merits of the converter and small open-hearth furnace for steel foundry service.

* * *

Machine tool builders of Cincinnati were considering a sliding scale standard contract form for castings. The prices varied with the quotations for foundry pig iron delivered in Cincinnati. For example with iron at $12 a ton, castings were to be $2.20 a hundred pounds. An advance to $28 in iron would permit the foundry to expect $3 a hundred pounds.

* * *

Beautiful thought! Suppose that the machine tool builders expected to follow the same sliding scale in their finished machines, never exceeding $3.13 a pound for lathes, presses and milling machines, etc.

* * *

Foundry iron at that time was selling for $21.65 Pittsburgh.

1917

AUTOMOBILE cylinder castings as produced at the plant of the Ferro Machine & Foundry Co., Cleveland, was the subject of the leading article in THE FOUNDRY for November, 1917. It is stated that a days output of 1100 to 1200 cylinders a day was possible at that time.

* * *

Contrasting the production of 1100 to 1200 cylinders a day with the present capacity of 4000 to 5000 a day at this same plant gives a measure of the progress made in this branch of the castings industry.

* * *

Foundry iron was selling at $33 to $33.50 in the north.

* * *

Foundry construction to take care of war demands was going forward. The Watertown arsenal, Watertown, Mass. was constructing a large new foundry to cost about $800,000.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Find the Facts

QUESTIONNAIRES designed to draw out information on gray iron castings production have been mailed to foundries throughout the United States. These were prepared after careful investigation by the bureau of foreign and domestic commerce of the department of commerce. Prompt and conscientious response on the part of the foundry industry is requested and the compilation of figures which this questionnaire will yield will be of great value to each one and to all of the great group of castings manufacturers.

THE foundry industry is a *basic* industry. Its products are vitally important to practically every line of manufacture. Progress made in the casting art has made possible machines, conveniences, and luxuries unknown to a previous generation. Despite the skill and technical knowledge which have made modern castings objects of engineering perfection, the industry has been strangely lax in the compilation of statistics. While the malleable and steel castings branches have set up through group organizations such machinery as is necessary to compile accurate totals of production and capacity, nothing of this nature is available to manufacturers of gray iron products except for certain specialties.

FOR this reason, those who for business reasons seek to study and appraise the facilities, and production of gray iron find themselves unable to proceed. While totals are offered through various agencies on the tonnage of cast-iron pipe, car wheels and a few such special products, the great total of all classes of gray iron castings remains unknown. This lack of knowledge is particularly unfortunate at a time when the friends of gray iron, as well as those who stand as competitors, find it impossible to prove or dispute the statements made regarding the industry and its progress or decline. If the department of commerce secures, AS IT SHOULD the cooperation of foundrymen, a real service will be rendered the industry. Further, the statistics will prove valuable as a basis for contemplated organization of the gray iron producers. They will furnish accurate information instead of guesses or the unsupported statements of competitors, and thus will indicate the line of activity to be selected for a business association of gray iron foundries.

¶ Vacation Cost Is Heavy

AS INDUSTRY again shows signs of accelerating production, due in part to the close of the vacation season, executives might profitably consider the advisability of introducing radical changes in present practices which prolong the vacation period over three or more months. More and more industry is finding it increasingly difficult to transact business during the summer months. Where vacations are taken on the relay plan, often enough key men are away at one time to hamper seriously the functioning of the organization at maximum efficiency. Decisions of importance to several companies are delayed until a certain executive returns to his desk. Salesmen are finding it difficult to secure orders in June, July and August, since the purchasing officer often is on a vacation. This condition not only costs in time, since the salesmen must make a second call, but naturally increases the cost of selling, a bill which is passed on to the consumer.

SEVERAL companies in recent years have been experimenting with a new plan which some claim greatly reduces the period during which an organization suffers from the ills of vacations. These companies close their entire plants for two weeks during the summer, when all employes, with the exception of a skeleton organization maintained to meet emergencies, take their vacations. The let down commonly extending three months, is reduced to two weeks. While numerous objections may be raised to this plan, any method which will reduce the indirect cost of vacations and at the same time increase the efficiency of the plant personnel should merit serious consideration.

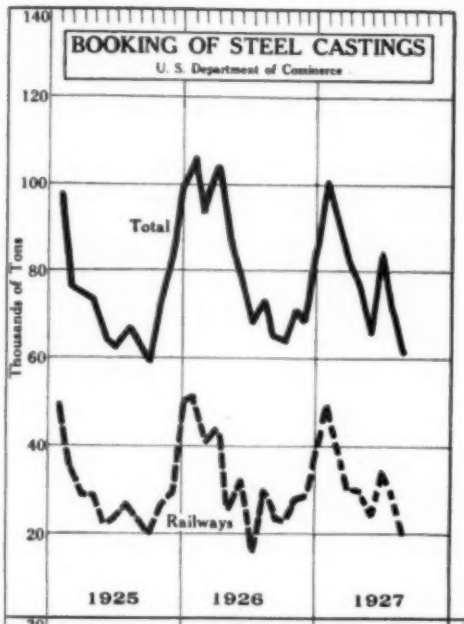
Trade Trends in Tabloid

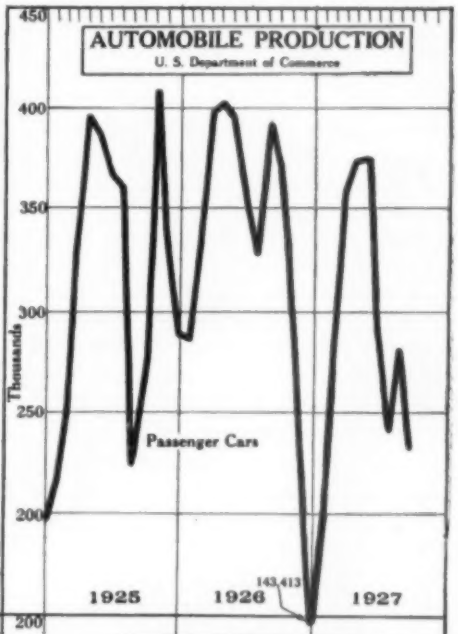
DESIGNATING the present business condition as one of profitless prosperity seems to apply in general to the foundry industry. Orders for castings are plentiful, although none are for large amounts, few are for other than immediate delivery and the prices are extremely close. Crop prospects and prices are inducing optimism as regards the farm buying power during the fall and winter. Implement and farm machinery sales are expected to increase next year. Employment figures show continued activity. Building construction is going ahead. Capital is available at low rates. Railway shipments are high. All of these factors have a bearing directly on the outlook for foundry business. Further, orders for jobbing castings from a wide variety of lines of manufacture have improved during the month of October. Slightly firmer commodity prices might be given as an added assurance of favorable prospects. Automobile production has declined and castings orders from this source are slow. Cast iron pipe prices apparently have turned the low point and started upward. Stove and furnace production rates are improving. Steel foundry operations are advancing slightly, although railway orders are slow. Malleable foundry operations for September showed 43.3 per cent of capacity. Orders declined from 42,515 in August to 37,912 tons in September.

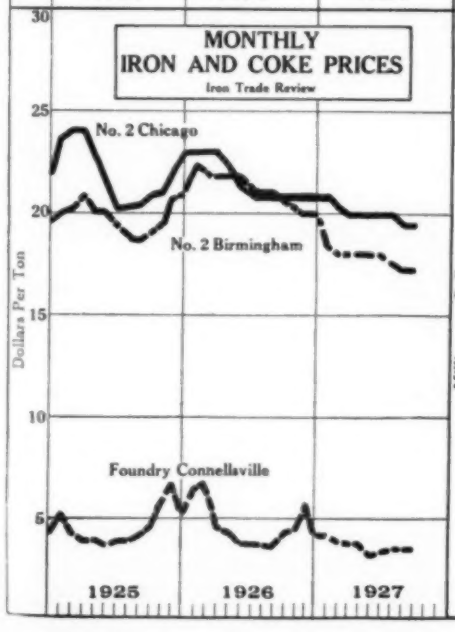
RAW MATERIAL PRICES

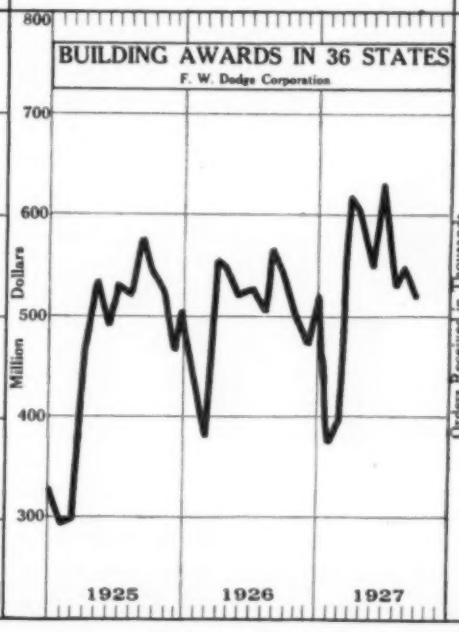
Oct. 21, 1927

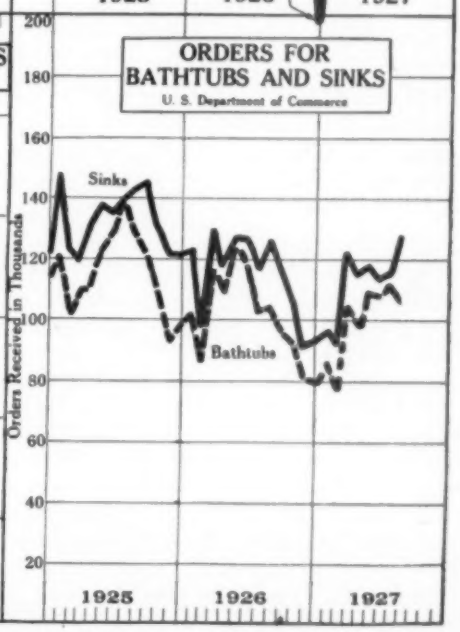
Iron	
No. 2 foundry, Valley	$17.50
No. 2 southern, Birmingham	17.25
No. 2 foundry Chicago	18.50
No. 2 foundry, Philadelphia	20.76
No. 2 foundry, Buffalo	17.00 to 17.50
Basic, Valley	17.00
Basic, Buffalo	16.50
Malleable, Chicago	18.50
Malleable, Buffalo	17.00 to 17.50
Coke	
Connellsville foundry coke	$4.50 to 4.75
Wise county foundry coke	4.00 to 5.00
Scrap	
Heavy melting steel, Valley	$14.75 to 15.00
Heavy melting steel, Pitts.	14.50
Heavy melting steel, Chicago	11.75 to 12.25
Stove plate, Chicago	12.00 to 12.50
No. 1 cast, New York	13.50 to 14.00
No. 1 cast Chicago	14.50 to 15.00
No. 1 cast, Philadelphia	16.00 to 16.50
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	14.00 to 15.00
No. 1 cast, Buffalo	13.00 to 13.50
Car wheels, iron, Pittsburgh	14.50 to 15.00
Car wheels, iron, Chicago	13.25 to 13.75
Railroad malleable, Chicago	13.00 to 13.25
Agricultural Mal., Chicago	12.75 to 13.25
Malleable, Buffalo	14.75 to 15.25
Railroad malleable, Pitts.	14.50 to 15.00
Nonferrous Metals	Cents per pound
Casting copper, refinery	13.00
Electro copper, producers	13.25
Straits tin	58.75
Lead, New York	6.25
Antimony, New York	11.00
Nickel, electro	39.00
Aluminum, No. 12, producers	23.50
Aluminum, No. 12, remelt	18.50 to 19.50
Zinc, East St. Louis, Ill.	6.00











Comings and Goings of Foundrymen

RAY M. CHENEY now is foundry superintendent with the Vermont Snath Co., Springfield, Vt., manufacturer of machinery castings. Mr. Cheney has been associated with the foundry industry for many years and for five years was superintendent and manager of the Union Foundry Co., Fitchburg, Mass., and then was connected with the Metals Production Equipment Co., Springfield, Mass., for two years. Mr. Cheney left this firm to superintend the construction and equipping of the new Philbrick-Booth foundry at Hartford, Conn. where he remained for two years. At the outbreak of the war he became supervisor of all foundry operations for the E. B. Badger & Sons Co., Boston, which at times had 14 foundries engaged in producing gray iron, steel and bronze castings. He resigned from the Badger company in September, 1919, to become associated with the Angus Co. Ltd., Calcutta, India, where he remained two and one-half years. On his return from India, Mr. Cheney became connected with E. Arthur Tutein Inc., Boston, and in January, 1924, joined the H. & B. American Machine Co., Pawtucket, R. I., He remained with the H. & B. company until July 1927 when he joined the Vermont Snath Co.

J. A. Lanigan has been made works manager of the plants of the Valley Mould & Iron Corp. at Sharpsville, Pa. and Hubbard, O.

W. J. Weir recently has been appointed foundry superintendent of the Mathews Steel Castings, Inc., Chicago.

Charles J. Butts, vice president and manager of the Jewell Steel & Malleable Co., Buffalo, for the past ten years has resigned, due to ill health and will reside in Los Angeles, Calif.

Otis Morgan formerly annealing and general labor foreman with the Chisholm-Moore Mfg. Co., Cleveland, has resigned. Previous to his association with the Chisholm company he was annealing foreman for Parlin Orendorf Co., for six years, with the Franklin Park Malleable Casting Co., for two years, with the St. Louis Malleable Casting Co., St. Louis, for two years and with the Standard Malleable Casting Co., Muskegon, Mich., for 11 years.

Henry J. Noble, who has been connected with the American Cast Iron Pipe Co., Birmingham, Ala. since 1910, and for several years superintendent of its main pipe foundry, has been anpointed assistant works manager of the firm. W. J. Bowers, formerly superintendent of the pattern shop, green sand and special foundries for many years, has been appointed superintendent of operations. E. M. Cole, traffic manager, has been elected a director of the company.

RAY M. CHENEY

Henry D. Miles, president of the Buffalo Foundry & Machine Co., Buffalo, for the past 25 years, recently was presented with a bound volume of letters of congratulations from 100 employes who have been associated with the firm for ten years or more. The volume was presented to Mr. Miles by P. J. Krentz, vice president, in behalf of the employes. A resolution of congratulations and appreciation offered by C. W. Pearson, vice president and treasurer, was adopted unanimously by the board of directors.

George Thompson will be the president and general manager in charge of all production of the Thompson-Owens Corp., Toledo, O., which recently has been organized to make bronze bearings and bushings, and brass and bronze castings. Mr. Thompson was superintendent and works manager of the Bunting Brass & Bronze Co., Toledo, O., for ten years. J. E. Owens, secretary-treasurer and sales manager of the new company was with the Bunting organization as salesman and sales manager for 14 years.

Discusses Gray Iron

The October meeting of the Pittsburgh Foundrymen's association was held in the Fort Pitt hotel, Pittsburgh, on Oct. 17. D. M. Houston, foundry engineer, International Nickel Co., New York, spoke on the improvement of gray iron. Mr. Houston has had wide experience as superintendent of automobile foundries at Indianapolis and later as chief metallurgist of a large foundry in Milwaukee.

Discusses Core Room

The regular monthly meeting of the New England Foundrymen's association was held at the Exchange club, Boston, on Oct. 19. An illustrated lecture on the operation and problems of the core room was presented by H. L. Campbell, assistant professor of metallurgical engineering, University of Michigan.

Buys Equipment

The Stoney Foundry Engineering & Equipment Co., Cleveland, has sold a core knockout machine to the Wilson Foundry & Machine Co., Pontiac, Mich., and shakeout and vibrator equipment to the International Heater Co., Utica, N. Y.; Wilson Foundry & Machine Co., Pontiac, Mich.; Lakey Foundry & Machine Co., Muskegon, Mich.; Buick Motor Car Co., Flint, Mich.; Griffin Wheel Co., Kansas City, Kans.; United States Radiator Corp., Geneva, N. Y.; Great Lakes Foundry Co., Port Huron, Mich.; Rundle Mfg. Co., Milwaukee; Dayton Steel Foundries, Dayton, O.; Henry Furnace & Foundry Co., Medina, O.; Ferro Machine & Foundry Co., Cleveland; Conemaugh Iron Works, Blairsville, Pa.; Worthington Pump & Mfg. Corp., Cincinnati; Ajax Iron Works, Corry, Pa., and the John Deere Tractor Co., Waterloo, Iowa.

Charles C. Phelps has been appointed sales engineer in charge of the metropolitan office, 30 Church street, New York, of the Hill Clutch Machine & Foundry Co., Cleveland.

Obituary

Charles R. Shupe, secretary, Challenge Machinery Co., Grand Haven, Mich., died Oct. 6 at the home of his sister in Milwaukee. Mr. Shupe was born at St. George, Canada, in 1866 and became associated with the Racine Hardware & Mfg. Co., Racine, Wis., when a young man. In 1920 he joined the Challenge company of which he later became secretary. He was active in community life of his city and for 12 years served as a member of the board of education. Mr. Shupe is survived by his widow, his son Dean and a sister, Mrs. Eva Luckrow of Milwaukee.

John H. A. Briggs, secretary, treasurer and director, Canada Foundries & Forging Ltd., Brockville, Ont., died recently at the age of 73 years. He was born in Morrisville, Ont., and came to Brockville when quite young, entering the service of the James Smart Mfg. Co., of which he become secretary-treasurer and later vice president. This company later was merged into the Canada Foundries & Forging Ltd.

Frank A. Gring, for 17 years president and general manager of the Franklin Brass Foundry Co., Reading, Pa., died recently at the age of 56 years. He was born and raised in Reading and was associated with the Reading Hardware Co. for 23 years. He founded the brass company in 1908.

Sherman Sanders, well known plow manufacturer of Chattanooga, Tenn., died on Oct. 2 at the age of 46 years. He was graduated from the Georgia Institute of Technology and during his entire business career was associated with his father, Senator Newell Sanders, in the Newell Sanders Plow Co.

Arthur G. Henry, metallurgist, Danly Machine Specialties Inc., Chicago, died on Oct. 5. He was born in Ebbw Vale, Wales, and received his education in Europe. He came to the United States in 1896 and in 1900 served as the first foundry chemist in Chicago for the Featherstone Foundry & Machine Co., later purchased by the American Brake Shoe & Foundry Co.

John Jacob Kinzer, Wildwood, Pa., superintendent, Pittsburgh Brake Shoe Co., and formerly a member of the Kinzer & Jones Foundry Co., Pittsburgh, died Oct. 15 at the age of 62 years. He was born in Pittsburgh and was an inventor, originating a patent on which the Brake Shoe company operated.

William C. Robinson & Son Co. and the Autoline Oil Co., have removed their offices to 34 Cambria street, Boston.

Sells Sand Separators

The Royer Foundry & Machine Co., Wilkes Barre, Pa., has sold sand separators and blenders to the Albrass Co., Coxsackie, N. Y.; the American Foundry & Machine Co., Hamilton, O.; the Hughes Tool Co., Houston, Texas; the Standard Foundry Co., Buffalo and the Waltham Foundry Co., Waltham, Mass. The Royer company also has sold one of these devices to the Fremont Foundry Co., Fremont, O., through the Mayor Fuel Saving Furnace Co., Cleveland.

Buys Gray Iron Foundry

American Manganese Steel Co., Chicago Heights, Il.l, has purchased the foundry of the American Brake Shoe & Foundry Co. on the south side of Chicago. At the present time the Manganese company is engaged in rearranging and equipping part of the plant for the manufacture of manganese steel with the electric furnace process. It also will continue to operate the gray iron foundry.

E. W. Ely, formerly assistant chief, division of simplified practice, department of commerce, has been appointed acting chief of that division. He succeeds R. M. Hudson, who has been promoted to assistant director, bureau of standards, in charge of commercial standardization.

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, HENRY S. CHAFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smoad avenue, Toledo, O.; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, HYMAN BORNSTEIN, Deere & Co., Moline, Ill.; secretary-treasurer, H. A. DEANE, Deere & Co., Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

Washington Foundrymen's Club
Seattle

President, RONALD KUCHER, Olympic Foundry Co., Argo Station, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks' Temple, Fourth avenue and Spring street.

He Designed Early Type Molding Machines

(*Concluded from Page* 862)

during 1907 and 1908, first as salesman and later as factory manager. He then leased a foundry at Cold Spring, N. Y., and was joined in the enterprise by a step-brother, W. S. Sutherland, recognized as a competent foundryman. Later, Mr. Sutherland retired to accept a position as foundry superintendent with Lord & Burnham, Irvington-on-the-Hudson, and since that time Mr. DuBois has carried on alone. He owns the foundry and adjoining property and has developed and installed many ingenious machines for molding specific castings.

When business slacks off a little and he has the necessary time he is going to devote his efforts toward the development of a machine, instrument or device that will prevent a mixup in the mails addressed to the 57 varieties of cold springs in the state of New York.

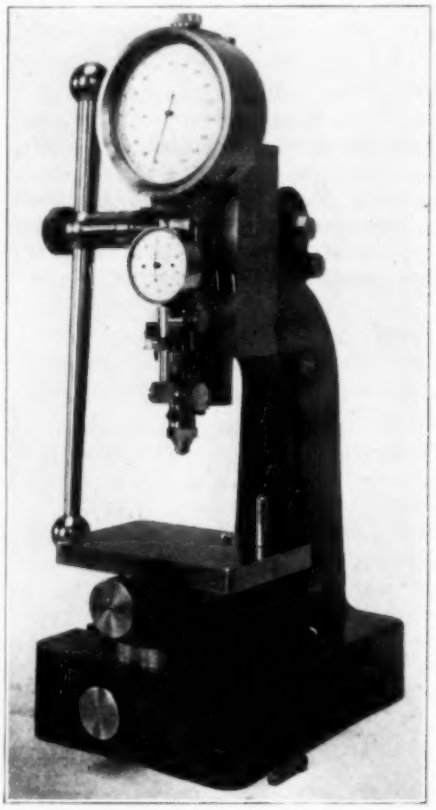
Buffalo Foundrymen Hold Meeting

The regular monthly meeting of the Buffalo Foundrymen was held in the club rooms at 140 Chandler street on Oct. 19. The speaker of the evening was Robert Heisserman, Link-Belt Co., Chicago, who spoke on elevating, conveying and power transmission machinery. His talk was illustrated with moving pictures and lantern slides which showed different installations of the machinery.

Machine Determines the Hardness of Metals

The Shore Instrument & Mfg. Co., Van Wyck avenue, and Carll street, Jamaica, N. Y., has developed a hardness indicator for measuring of what is known as quantitative and qualitative hardness in metals and all other materials. The instrument is a static mechanical pressure machine acting on a small diamond ball impressor through a specially designed high duty weigher or pressure scale. The resulting depth of impression under load is measured by a standard micrometer gage reading to 1/5000 inch. The graduated pressure scale has a capacity of 160 kilograms and also reads up to 352 pounds. The successful operation of the unit has been made practical by the introduction of a compensator device on the indicator that serves to correct errors due to contraction of the parts in the machine and the diamond itself when under strain.

The diamond ball point is ⅝ millimeter in diameter and it is made to penetrate the material to a depth of 9/5000 inches, thus producing an impression diameter of 0.36 millimeters. The comparative hardness



SPECIAL SCALES MAY BE APPLIED TO THE HARDNESS TESTER

of the material is measured in terms of the pressure necessary to produce this constant impression. The result may be expressed in per cent of hardness as compared with steel of known hardness. The diamond size was chosen so that the scale will include all metals from the softest up to the hardest steel without unduly straining the diamond on hard specimen. The resulting impression causes slight injuiry to the finished surface.

Special scales may be applied to the instrument to read in terms of scleroscope and brinell hardness numbers, or unit stress values may be used. A diamond of any other shape or standard steel balls of larger size may be used for special purposes, particularly for accelerating the examination of soft metals. By a comparative method, these values are always reducible to the standard values.

With a flat end punch of constant diameter, it is possible to measure the comparative ductility of metals. In this case a constant pressure of 125 kilograms is applied and the depth of impression is the variable factor being proportional to the ductility. It is also possible to measure the depth of hardness by plotting the load against the depth of impression. If a steel specimen is decarbonized so that it is harder inside than out the increment line will bend upward. If on the contrary the specimen is case hardened, but of limited depth, the increment line will bend downward as the load is increased.

In operation the specimen is put on the table of the machine with the top surface approximately level, and the ram is advanced downward until the hexagon cap contacts with the piece. The hand lever on the side is then removed until the lower or micrometer gage hand is moved to a responsive resting position, at which point the micrometer needle is adjusted to 0 through the medium of a thumb screw. The hand level is again moved until the idler pressure bar reaches the weigher mechanism. At this point the indicator hand on the micrometer gage also moves until the required definite penetration is reached. For standard hardness measurement this would be 9 divisions of the scale. The pressure reading is then taken from the larger dial in kilograms or pounds.

Pressure is furnished through a simple plate spring loaded as a beam in the center and carried on roller bearings. The spring is checked with a weigher scale. A special built-in micrometer mechanism transmits the deflection of the spring to the needle of the dial. The tester has a capacity between the base and impressor point of 7 inches. The largest distance from the center to the back of the frame is 4¼ inches. It has a minimum height of 17 inches and weighs 61 pounds.

Appointed Sales Manager

Melvin J. Evans has been made sales manager of the Whiting Corp., Harvey, Ill. Mr. Evans was graduated from the University of Wisconsin, Madison, Wis., in 1913, and then became connected with the Atchison, Topeka & Santa Fe Railroad, where he served in the machine shop, assembly shop, boiler shop, round house and the locomotives department. During the war he was a lieutenant in the ordnance department and was stationed at the ordnance proving grounds at Aberdeen, Md., and at Savanna, Ill. At the latter place he was in charge of proof firing of artillery. After the war he decided to discontinue railroad

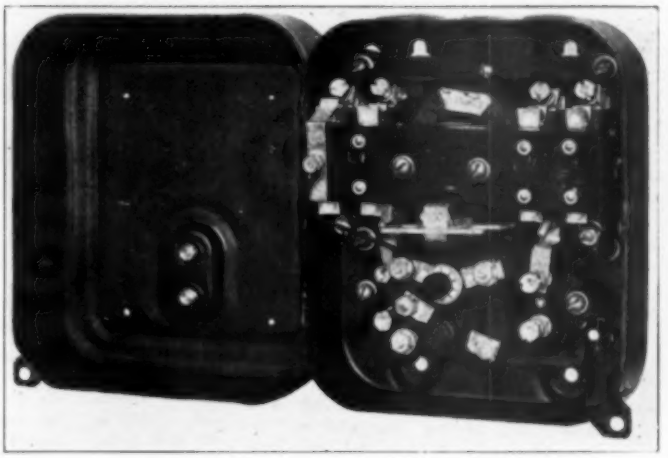
work and became assistant to the vice president of the Doehler Die Casting Co., Brooklyn, N. Y., where he remained three years. He then became works manager of the Templeton, Kenly & Co. Ltd., Chicago, manufacturer of railroad equipment. He remained with that company three years and then became sales manager of the Republic Flow Meters Co., Chicago. He also was connected with the advertising work of that company. While Mr. Evans will be sales manager of the Whiting Corp., N. S. Lawrence will continue as vice president in charge of sales.

Uses Portable Conveyor To Handle Refuse

Foundry refuse may include any kind of material found in clean-up work around the foundry. This refuse usually is rough, heavy material and can be handled only with a machine of large capacity. The conveying unit is also subject to abuse by the class of labor which does the clean-up work. Foundrymen, as a rule, use stationary apron type conveyors for handling foundry refuse thinking that no other machine can handle the work. However, one company has found that an entirely different type of machine can be used effectively.

In June, 1923, the Midvale Co., Philadelphia, purchased a standard portable belt conveyor from the Link-Belt Co., 910 South Michigan avenue, Chicago, with the idea of using it for the handling of foundry refuse. This method has been exceptionally successful and economies have been effected due to the fact that the machine can be moved from place to place. Mr. Boss, the yard superintendent of the Midvale company, has found that the capacity of this conveyor is sufficient to take care of six men shoveling material at one time.

When there is no foundry refuse to load into railroad cars the conveyor is transferred to the sand storage shed and there used to unload the sand from gondola cars into storage. This conveyor is equipped with standard 18-inch wide belt with 1½-inch high cleats, and continuous skirt boards the entire length of the conveyor which prevents the large brickbats and large lumpy material from falling over the sides and rolling back.



THE STARTER HAS PUSH BUTTON CONTROLS WHICH ARE LOCATED ON THE FRONT COVER

Starter Is Compact

The Cutler-Hammer Mfg. Co., 323 North Michigan avenue, Chicago, recently has introduced a new starter for electric motors. This new product handles motors of 5 horsepower and under, gives push-button control of starting and stopping, and provides thermal overload protection and no-voltage protection.

The starter is provided with push-buttons in the front cover of the case. The small size in most cases permits mounting of the starter where the control station ordinarily would be placed and the extra wiring and cost of a push-button station is saved. However, one or more push-button stations may be used if such type of control is desired.

A feature is the type of contactor developed for use in this starter. A roller is forced between two fingers to complete the circuit. Thus a double break, and a wiping contact are secured. This arrangement reduces arcing. To adapt the starter for any horsepower within the rating, it is necessary only to insert the proper size heater coils in the thermal overload relay.

Completes Fatigue Tests on Cast Iron

Until the present time few test data have been published regarding the capacity of gray cast iron to resist repeated stress. The University of Illinois, therefore, in co-operation with the Allis-Chalmers Mfg. Co., Milwaukee, undertook to make a series of fatigue tests on cast iron. The results are published in bulletin No. 164 of the engineering experiment station, Urbana, Ill.

In the investigation two distinct problems were recognized: 1. The study of the strength of cast iron as a material, and 2, the study of the effective strength of the material in different parts of a casting. The results in general may be considered as contributions to the study of the strength of cast iron as a material, although one series of tests was made on specimens cut from the inner wall of a large iron cylinder with double walls.

Static tests, impact tests, and fatigue tests were made on specimens from four different lots of gray cast iron. The results of the tests should be regarded as giving some suggestive information concerning the fatigue strength of cast iron rather than as giving comprehensive test data.

Fenton Foundry Supply Co., Gilbert and Master avenues, Dayton, O., has been appointed representative in the Cleveland territory, in addition to its present territory, for the Royer Foundry & Machine Co., Wilkes-Barre, Pa.

THE CONVEYOR IS USED TO UNLOAD SAND FROM THE CARS

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

American Die Casting Co., Canton, Ill., T. Littman, president, contemplates building a 1-story machine shop.

McWane Cast Iron Pipe Co., 3700 North Eleventh street, Birmingham, Ala., plans to build a 1-story foundry addition, 28 x 160 feet.

Mesta Machine Co., West Homestead, Pa., has awarded the general contract to the Austin Co., Cleveland, for its 1-story manufacturing plant.

Callender Foundry & Mfg. Co., Guelph, Ont. has let the general contract for an addition to its plant to D. Barclay, 24 Melville avenue.

Soss Mfg. Co., Inc., 776 Bergen street, Brooklyn, N. Y., manufacturer of hinges, and similar products, will discontinue its die casting department.

Bellwood Foundry & Machine Co., Bellwood, Pa., plant was damaged by a recent fire. The owners have not decided whether to rebuild.

Marshall Foundry Co., tract 220 x 475 feet on Allegheny Valley railroad and Twenty-eighth street, Pittsburgh, has been sold at public auction to A. E. Sloan for $103,000.

Woodward Pattern Works, South Bend, Ind., has awarded the general contract for its new 2-story plant, 40 x 100 feet, to Hay Weaver Co., 2300 South Main street.

New Jersey Valve & Casting Co., Inc., 224-30 Clay street, Paterson, N. J., has been organized to manufacture valves, steam fittings, etc.

Carondelet Foundry Co., 2101 South Kingshighway, St. Louis, has awarded the general contract for alterations to molding room to W. Ferris & Co., 2929 Locust street.

J. & B. Foundry Co., Talladega, Ala., maker of cast iron specialties, is nearing completion of construction of its new foundry. The foundry is expected to be in operation by Nov. 1.

Nash Motors Co., Kenosha, Wis., has awarded the contracts for two additions to its works at Racine, a heat treating shop, 90 x 170 feet, and a storage building, 40 x 100 feet, to Nelson & Co., Racine, Wis.

Perfect Circle Co., Newcastle, Ind., maker of piston rings, plans to install new foundry equipment, electric furnace apparatus and other equipment in its contemplated expansion.

L. C. Smith & Corona Typewriter Corp., East Washington street, Syracuse, N. Y., has awarded the general contract for a 2-story addition to Dawson Bros., Union building. C. D. Corwin is the manager in charge for the company.

Capital Brass & Aluminum Foundry Co., 2452 Fullerton avenue, Chicago, has been incorporated to manufacture brass, bronze and aluminum castings. W. Hunter is president, F. Kerbs, vice president, R. Utley, treasurer and F. Haack Jr., secretary.

The general contract for the brass foundry, core room, melting building and chemical laboratory for the Canadian Westinghouse Co., Hamilton, Ont., has been awarded to W. H. Yates Construction Co., Hamilton. (Noted Oct. 15).

H. A. Miles Mfg. Co., Ft. Worth, Tex., Ben W. Frieden, secretary, Holmes building, has awarded the general contract for a plant 75 x 100 feet for the manufacture of stoves and gas heaters, to Wood W. Graham, 3433 Avenue M. (Noted Oct. 15.)

Buck Stove & Range Co., St. Louis, was damaged badly by the tornado which occurred recently in that city. Contracts for the rebuilding the upper stories and roof of the plant were signed five hours after the tornado and workmen were busy the day following.

Pyott Foundry Co., Chicago, has leased from William C. Pyott, the foundry and machine shop, 235 x 200 feet, on Carroll and Sangamon streets, for 5 years at an annual rental of $37,500. Mr. Pyott previously took title to half interest in the property from the foundry company.

Stockham Pipe & Fittings Co., Birmingham, Ala., has started its newly installed electric furnace and is producing high-pressure fittings. The capacity of the department will be 500 tons of castings monthly. Steel scrap is utilized and a crane runway 875 feet long has been built over the scrap yard.

Davenport Brass Foundry, Davenport, Iowa, recently incorporated to take over a partnership and increase capital, is building an additional foundry to increase production from 20,000 to 30,000 pounds of brass per day. Four oil-fired melting furnaces are employed. Frank B. Meckel is president, Orion G. Meckel, vice president, George G. Meckel, secretary, and John B. Phillips, treasurer.

Thompson-Owens Corp., Toledo, O., recently incorporated to manufacture bronze bushings and bearings and brass and bronze castings, has acquired a plant at York and Wheeling streets, which is being equipped with new machinery. Production is expected to begin Nov. 1. George Thompson is president and general manager. He was general superintendent and general manager for the Bunting Brass & Bronze Co., Toledo, for 10 years. J. E. Owens, secretary, treasurer and sales manager, was with the same firm 14 years as salesman and sales manager.

New Trade Publications

NICKEL ALLOYS—International Nickel Co., New York, has compiled a second edition of its buyers' guide. This is a classification of producers and fabricators of nickel alloy steel. The present listing contains additions and changes since the first was issued.

ELECTRICAL EQUIPMENT—General Electric Co., Schenectady, N. Y., has issued a number of bulletins on its equipment. Current issues include: Direct heat electric furnace, automatic reduced voltage starters, cartridge units, metal melting pots, mechanical drive turbines, push and pull switches, electric turbines, duplex controllers, direct-current motors for steel mill main roll drives.

INDUSTRIAL HEATING—A catalog of industrial electric heating appliances has been issued by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Twenty-seven types of equipment are listed, covering a wide variety of industrial uses. Production curves are given, to enable accurate estimates of current consumed. It is well illustrated.

TUBE COUPLINGS—Parker Appliance Co., Cleveland, has issued a booklet covering its line of couplings for copper tube water and gas services. Methods of coupling lengths of tubing with its appliances are illustrated.

MOTORS—Wagner Electric Corp., St. Louis, has issued two bulletins, dealing with its across-the-line standard squirrel cage motors and its air-jacketed motors. Details of construction and specifications are given.

NONFERROUS ALLOY—American Mond Nickel Co., Clearfield, Pa., recently has published a 16-page, pocket size booklet describing the properties and uses for its new copper-nickel alloy. This alloy is designed for making castings to withstand elevated temperatures and to resist corrosion and erosion. Data on various tests performed on the metal and instructions for handling in the foundry are included.

CRANES AND TROLLEYS—H. D. Conkey & Co., Mendota, Ill., has published an engineers' data book, containing complete specifications, clearances, list prices and other crane and trolley information for engineers and users of crane and trolley equipment. It contains also a catalog of light cranes. It is illustrated and has many tables of data.

ELECTRICAL EQUIPMENT—General Electric Co., Schenectady, N. Y., has issued a number of bulletins on various types of equipment. They include: Metal melting pots and equipment; air heating units; air compressor governors; squirrel-cage motors; adjustable varying speed motors; synchronous motors; motor-starting switches; vertical induction motors; disconnecting switches.

MATERIAL HANDLING—Lakewood Engineering Co., Cleveland, has issued a catalog of its equipment for material handling in industrial plants. Its storage battery lift trucks are shown in detail. Standard units and special types are presented. It is well illustrated, showing methods of reducing costs in storage and interplant transportation.

ELECTRICAL APPARATUS—Allen-Bradley Co., Milwaukee, has published several new bulletins for incorporation in its catalog to bring it up to date. The bulletins deal with its controlling rheostat, semiautomatic resistance starter, slip ring motor starter, alternating current contactor, alternating current reversing switch, across the line switch and automatic slip ring starter. The bulletins also are accompanied with price lists and revised price lists. The bulletins and price lists are of the loose leaf type for insertion in the firm's catalog.